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THE AUTOMOBILE AND THE RAILWAY AS TRANSPORT AGENTS.

By Sylvester Stewart.

THE poet says of vice that we first endure and then embrace it. With the new discovery or improvement we first flout, then over-estimate it. For a long time after the successful introduction of the electric light it remained a prime favorite with forecasters who loved to tell how it was going to put out gas. Then came the bicycle which was to reduce greatly the earnings of street railways. Today the chief among the menacers of trembling stockholders in existing things is the automobile. Many editorials and other articles in newspapers and magazines tell us that this light locomotive running upon macadam is going to make great inroads on the business of the railways, and some of the prophets—among them no less a personage than Sir Henry Norman, M. P., editor of the English edition of *The World's Work*— predict that it will wipe out the railway.

Let us take for a text Sir Henry's article on "The Coming of the Railway" in the April number of his magazine, in which article he

Mr. Stewart's article was written and, indeed, in type, some time before the shocking fatalities of the Paris-Madrid race came to confirm so grewsomely one aspect of his conclusions. His letter, written since that event, appears in our Editorial Comment in this number.

It seems from certain reports, however, that it will take even more than that tragic lesson to teach some of the wrong-headed and dangerous advocates of the automobile what its true friends fully understand. That is, that the competition of the motor vehicle is not with the locomotive on rails at all; neither in economy of haulage nor in the practical attainment of

sailed upon the clouds of enthusiasm till lost among the peaks of peradventure. Other articles of the same tenor have since appeared (in one in *Munsey's Magazine* for May a writer says, "Fast as a locomotive may go an automobile may go faster"), but a reply to Sir Henry will serve as a reply to all writers equally deluded.

After predicting that "the automobile will kill the railway," Sir Henry asks:—"Why should the community pay a huge sum per mile for a special roadway [steel rails] for cars, and a huge generating station, when self-propelled motor omnibuses of equal speed, comfort, capacity, and economy can use the common road, and by their ability to be steered around obstacles, not interfere with the rest of the traffic?" and continues:—"Few of our leaders of opinion have yet realized that we are on the eve of a more momentous change than that inaugurated by Watt and Stevenson."

The traction or pull of a vehicle on the best macadam road is at least four times as great as on steel rails, and on some macadam roads it is eight times as great. The steel road is as much better than macadam as macadam is better than mud. The traction of a ball-bearing vehicle with large wheels and small axles could be reduced to four pounds per ton on level rails, making it possible for a rabbit, rooster, or tom cat to pull a man. A locomotive which cannot propel itself alone more than twenty-five miles per hour on the best macadam road, can pull a long train at that speed on steel rails, allowing it to use flangeless wheels on macadam and flanged wheels on rails.

Running cars on steel rails has changed the world more than any invention ever made, extending commerce, spreading civilization, promoting peace, unifying nations.

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speed in travel can it ever compete with, or even approach, the work of the locomotive. That work, as Mr. Stewart shows, is accomplished in connection with other elements quite as important to the result as the engine itself. These are the fixed railway, the minimizing of curve and grade, the movement of large units by a definite schedule, and not least, the absolute control of all movement by an elaborate signal system. And every one of these factors is wholly excluded by the essential theory of the automobile.

The field of the motor vehicle is one which scarcely overlaps at all that of the railway locomotive. It is one which it holds not by rivalry with the railway engine in fast running or cheap hauling, but by qualities of its own, which the heavier machine totally lacks. These are, in chief, freedom and individuality of movement and adaptability to small-unit service. As a "house-to-house" transport agency for freight or passengers beyond the network of the railway, or where the traffic is not dense enough for the railway, it is destined to be an invaluable adjunct, auxiliary, and supplement to the locomotive. Here it is supreme as a transport agency. But as a mile-a-minute road racer it is a nightmare and a Juggernaut; and the gentlemen who show us that a sixty-horse-power car can be sent a mile along an open road in three-quarters of a minute, much as we may marvel at their nerve, contribute not a whit more to the beneficent economy of the world's work than the other gentlemen who "loop-the-loop" on bicycles or dive from high platforms into shallow tanks. —THE EDITORS.

That it is the steel rail more than the locomotive that has worked these wondrous changes is shown by the facts that the locomotive at work off of steel rails has accomplished very little, although it has been in actual or attempted use longer than the locomotive on rails, and that railways without locomotives (horse-railways and cable-railways) are able everywhere to carry passengers three to five times as far for a nickel, as any vehicle on any other kind of road; even though the vehicles on the common road have their roadway built and maintained for them free by the taxpayers, while the railway company has to maintain not only its track, but on city lines, the paving of the street between the rails, and to stand the wear of thousands of wagons using its rails, besides paying in many cases a large sum for its franchise.

As to freight, the average cost of hauling by road locomotives is at least 10 cents per ton per mile, but on railways it is only 7 mills (on the Pennsylvania railway ½ cent) and this charge covers the cost of maintenance of the track and interest on the original cost of construction, or double the cost of construction, if the stock was well watered, while as we have said, the roadway for the locomotive using the macadam is *built and maintained by the public.*

It may be said that it is the long haul and the haul on a large scale (long trains) which makes the one-half cent per ton-mile possible. Answer:—

1.—It is the steel rail which makes the long train possible. 2.—The short-haul rates are only one to two cents per ton-mile, or five times the speed and one-fifth to one-twentieth the cost by the road locomotive.

It may be asked by Sir Henry Norman or others, why the railway locomotive, if as efficient as I claim, does not pull passengers at a lower rate. Because it gives passengers so much room, comfort, and high speed, that it has to carry a ton of dead weight for each passenger. A locomotive weighing 100 tons pulls, at 45 miles per hour, 12 cars weighing 600 tons and containing 760 people, weighing 50 tons, assuming the passengers to be men, women and children, but chiefly men, and to average 131 pounds each; 1,400 pounds of dead weight per passenger, when every seat is taken. But cars cannot average more than seven-tenths full.

The railway carries free the passengers' 150-pound trunks, and sends with him toilet-rooms, heating stoves and fuel, smoking rooms, dining rooms, and bed rooms. These houses on wheels, and the locomotive which draws them, have to be made very heavy in order to get the great strength made necessary by high speed. If the railway could dispense with these comforts and luxuries, and carry passengers packed

closely inside and on top of low-roofed, ramshackle, unheated vehicles, like the old stage, and at slow speed, it could pull passengers at one-tenth to one-twentieth the price of the old stage.

It has been said of the Pilgrim Fathers "We like them for ancestors, but would hate to have them for neighbors"; it could be said of the old stage "We like it for its picturesqueness, but we would hate to ride in it." We continue to admire it on condition that it will not return. I admit that for a short ride in fine weather the stage was, and the automobile is, enjoyable; but before a passenger can be well protected from dust, wind, rain, and cold, and furnished with pure air through openings 14 feet above the ground, as in a railway car, the automobile must be built as large and heavy as that car, which is a development not probable. Owing to the great weight of the housed-in car, automobiles are made open, or merely have carriage-tops, and trust to providence for weather. When I see an automobilist covered with mud and wet with rain, I think of the Scotchman who arose in a theater, after two hours of doleful tragedy, and asked the tragedienne, "Do you call this diversion?"

If the immense traffic of a long-distance railway, on which hundreds of trains must run at night, were transferred to a macadam road, that road would have to be lighted its entire length, or every vehicle would have to carry a light as powerful as, or more powerful than, the railway locomotive now carries. As a locomotive on macadam could not round curves with a train of more than two cars, it would be necessary to use ten to twenty times as many locomotives as now, which would mean much greater expense for light.

Having now replied to Sir Henry's claims of "equal comfort, capacity and economy," we come to the question of "equal speed." Here again the facts strike Sir Henry heavily and knock him out with fearful force. The highest speed (a mile in 46 seconds) made on macadam by a powerful automobile built especially for racing, with 70 or more horse power allowed for the propulsion of two men, has been far exceeded by locomotives on rails, hauling trains. How fast would the automobile go on a macadam road, if pulling a train of three cars, each as large as itself and filled with passengers, and how much dust would a man breathe in a day on that road, supposing as much traffic upon it as passes over some railways? Locomotives running alone have achieved a speed of 120 miles an hour.

As to "steering around obstacles," it is one of the great disadvantages of vehicles not on steel rails that they must be constantly steered around each other, thus pursuing a serpentine course, which adds to

the distance and makes high speed dangerous. 60 miles per hour is safe on rails; 15 miles is dangerous on macadam, as would soon be realized if the immense traffic on one of our railways were thrown on to a macadam road. On a railway we see thousands of cars daily passing thousands of others, almost touching, yet so accurately guided by the rails that accidents are rare, and would be much rarer if we could be satisfied with 15 miles per hour, all that we could expect from passenger and freight vehicles running on macadam.

Sir Henry speaks of the "huge cost" of the railway. Considering the large traffic that can be carried on a steel track its cost is small. It would require five of the largest auto omnibuses now made to carry as many passengers as are packed in one trolley car. Again, the macadam road would cost much more than it does now if built to sustain mammoth autos carrying seventy passengers, the number that many trolley cars carry during rush hours. To carry passengers in small vehicles is too costly. One conductor and motorman must handle loads of fifty or more passengers. If the 100-ton locomotives now in use on railways were to run on macadam the deep stone foundation necessary to sustain them would make that road cost more than a railway, for the rails and cross-ties, by their length and stiffness, distribute over a considerable area the weight which, on a stone road, falls too heavily in one spot. It may be said that on account of the superior adhesion on macadam the locomotive running on it would need to weigh but half as much as if on rails to exert the same pull. But the pull on macadam is only one-fourth as effective as on rails, hence the road locomotive would have to weigh 200 tons, and use four times as much fuel as the railway locomotive in order to pull as heavy a train.

As to comparative cost of maintenance of roadway, there are not sufficient data on which to base a conclusion, but it is probable that a dollar's worth of steel will outwear a dollar's worth of macadam. The life of a traction engine is four or five years; the life of a railway locomotive is fifteen to thirty-five years. All roads but steel are hard on heavy engines.

As to "huge generating station," that is equally applicable to a rail or road locomtive system. It may be added to, or omitted from either.

As to a "change greater than that inaugurated by Watt and Stephenson," they inaugurated the running of motor vehicles on common roads, as well as on rails, for Watt invented the engine, and Stephenson successfully put it on wheels. They built for all roads, but Stephenson showed that the metal road permitted higher speed and

lower rates than any other, even when the rails cost fourteen times as much, per degree of durability, as now. For, before the era of cheap steel, iron rails were used, rails which cost more than twice as much per pound as steel rails cost now, yet wore only one-seventh as long.

Vehicles have been greatly improved since Watt and Stephenson towered among the tiny ones, but the railway will gain as much as the common road from that. Ball-bearing vehicles have been so well perfected that they will run by gravity, on a first-class macadam road, down a grade of 32 feet to the mile. But on rails they will run by gravity down a grade of 8 feet to the mile, a grade so slight that, to the eye, it seems level. Ball-bearing vehicles on rails will in many cases, on farmers' railways on wide plains, carry sails for auxiliary power; and many vehicles will on light railways use only manual power and sails. These developments may wait till fuel becomes much dearer than now, but a sail which propels a boat 15 miles per hour, would, in the same wind, propel five times as much load at the same speed if the load were placed on ball-bearing cars on level steel rails. And the same effort that a man exerts in propelling himself 10 miles per hour on a bicycle on an ordinary macadam road would propel at least 800 pounds of butter, eggs, etc., at that speed on a properly constructed vehicle and railway. Or it would propel at least a ton at the rate of 4 miles per hour. We must either admit this or declare all reported traction tests to be falsehoods, and all engineering works to be romances.

That the automobile has a great future I do not deny. Its chief mission is to change city streets from manure yards to clean thoroughfares. The horse is unfit for use on city streets. He occupies too much space; he is too hard to steer; he has the wrong kind of feet on him; besides, on crowded streets, his worried driver whips, frets, and jerks 10 per cent. of his energy out of him, and shortens his life. Permitting horses in cities is cruel and wasteful, and is injurious to both horses and men.

But whatever efficiency the auto may attain by future improvements, it will always remain true, that if it is put on steel rails, the same engine and the same quantity of fuel necessary to pull ten passengers or one ton of freight on the best macadam road, will pull at least forty passengers or four tons of freight on steel. So, instead of "making railways obsolete," the auto will call for light steel rails for itself, in hundreds or thousands of localities, and will probably be equipped, in many cases, with guides, so that it can run either on or off rails.

The automobile, instead of being a menace to the railway, will be a feeder to it. Light railways—T rails, plateways, etc.,—will branch

from main lines, and on these branches will run freight and passenger automobiles. The automobile's misfortune at present is the mistake of its admirers—their supposition that it can reach high efficiency on stone roads. It can for pleasure, but not for business. The best friend of this promising child is he who tells it to get onto the road its father, the locomotive, found the best. In roadways there is nothing like steel, nor anything that makes any approach to it. Of course in sections too thinly settled to justify two roads (a common road and a light railway) the business automobile will have to use the common road, but wherever it does so it will be compelled to charge a high rate for freight and passengers, on account of the great resistance to progression encountered on all roads but steel.

In the above paragraph reference is made to the flat 12-inch-wide steel rail (plateway rail) recommended by some for country roads and city streets. Its cost is higher and its efficiency lower than other forms of rails for light vehicles, but vehicles without either flanged wheels or guides may run on it. It would be too much of a strain on eyes and nerves of drivers of either autos or horses, especially the latter, to keep on it, except with frequent intervals of rest, and it encroaches upon the horse's path, causing him to slip and fall, for the horse is a poor skater.

But after horses are barred or taxed out of cities, and steel rails laid on all streets for all vehicles to run on, as I think they will be, it will probably be found that, for thronged streets, the plateway will serve better than rails which require the wagons or autos which use them to have either flanged wheels or guides. The plateway will not keep as free from dirt as other rails, but even on a plateway, if nearly level, a man could propel as heavy a load as one horse hauls on a badly paved street. Hence when the majority of residents in any city realize that horses should be barred out, they can answer those horse-users who claim that they are too poor to buy a motor wagon: "We will put down plateways on which a ball-bearing vehicle will almost run itself, and you can yourself propel your wagon on it, and not be worried with a horse, or be compelled to feed or shelter one; at steep places we will have moving ways to carry your wagon up, or moving endless cables to pull it up. It is as natural for man to oppose everything that is good for him as to cry for things that hurt him."

THE DEVELOPMENT AND USE OF THE SMALL ELECTRIC MOTOR.

IV.—APPLICATIONS TO GENERAL MANUFACTURING PURPOSES.

By Fred M. Kimball.

With this article, Mr. Kimball concludes a series which began in our April number and which in its entirety constitutes a comprehensive practical review of the economy of the electric motor, and the principles governing the choice, installation, and operation of motors for power purposes in the machine shop, factory, and industrial and domestic establishments in general. The May and June numbers were especially noteworthy for the definite data they gave as to power requirements of standard metal and wood-working tools. This has an active interest of a different sort in its suggestiveness of the wide range of uses to which the electric motor may be applied.

The "General Electric" motors illustrated throughout this article and the preceding papers by Mr. Kimball are those manufactured by the General Electric Co., of Schenectady, N. Y., and in England by the British Thomson-Houston Co., of Rugby.—THE EDITORS.

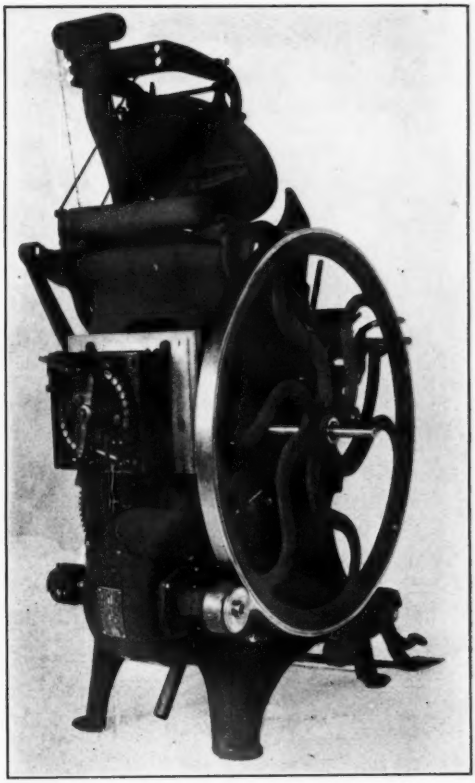
IF one makes even a cursory survey of the mechanical processes carried on in connection with the varied lines of industry throughout the United States, he cannot but be astonished at the large number of electric motors, of small and medium size, which are employed in nearly every manufacturing business. The problems involved in thus applying motors to the operation of various classes of machinery in various lines of work are exceedingly interesting, and a notable portion of the best talent which the country affords has found full employment in advancing the art, both theoretically and practically, during the past twelve or fifteen years.

The printing trade offers an admirable field for the efforts of the motor salesman and engineer. It was one of the first to be carefully exploited. Presses, stereotyping machinery, folding, binding, embossing, and stitching machines, are all particularly adapted for receiving the electric drive.

The requirements of press operation are such that an electric motor forms an ideal adjunct to almost any variety of press, large or small. The work of a printing press is unavoidably intermittent. If a motor is employed to drive it, then when the press is stopped all expense for power ceases. With any other form of power transmission, friction, condensation, or leakage losses are nearly constant.

When a line of presses is driven from a countershaft with its attendant overhead belts, etc., not only are the belts much in the way, but they are constantly generating static charges of electricity which in turn cause lint and dirt to adhere to them until the weight of these accumulations overcomes the static effort and then these masses are

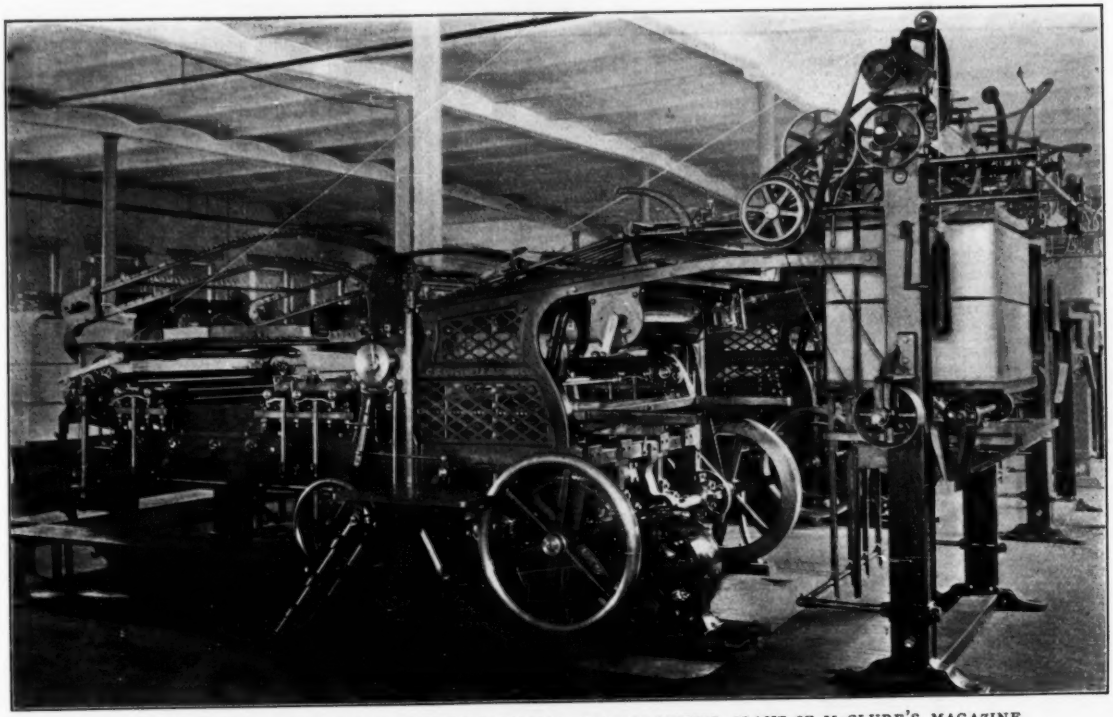
oftentimes thrown off into the press, where they smutch the work and fill the fine lines of the types or cuts with a substance which is removed with much difficulty, and at the expense of much valuable time. A very large percentage of fine work is spoiled by this dirt and the drip of oil from overhead hangers each year in every shop where the belt drive is used. Again, presses require frequent speed variations to accommodate the different varieties of type, ink, and paper which are used.



GOLDING JOBBER, FRICTION DRIVEN FROM ½-HORSE-POWER GENERAL ELECTRIC MOTOR.

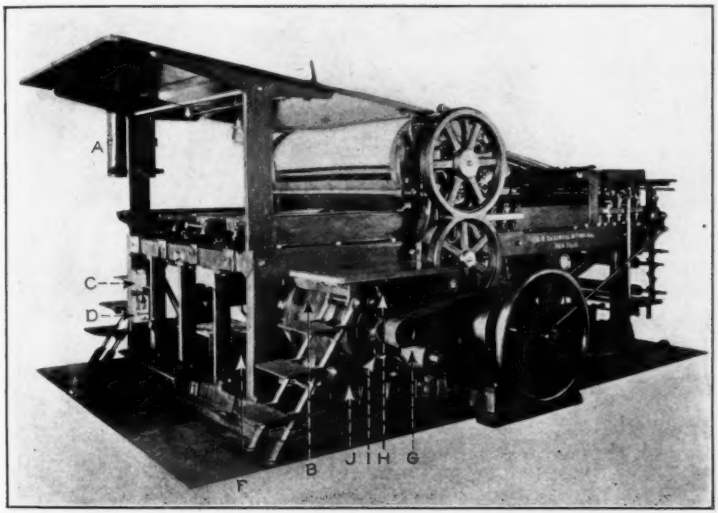
Experience has shown that the substitution of electric motors for other mechanical means of driving printing machinery enables the output to be increased very materially in almost any given case. This is largely due to the wide yet finely graduated range of speed control which it is possible to obtain. In the case of a mechanically driven press operated through the medium of belt-connected cone pulleys, the increase of speed from the lowest to the highest is, usually, about 125 per cent., but this great increase can be made in only about four steps. The same increase may be divided into eight, ten, or even more steps when the electric motor with proper controller is used.

With pulley-and-belt transmission it may readily happen that a certain step is too fast to produce perfect work with safety, while the



GROUP OF PRESSES, ELECTRICALLY DRIVEN BY GENERAL ELECTRIC MOTORS, PLANT OF McCLURE'S MAGAZINE.

next larger driven cone gives a speed much less than might otherwise be used. When the electric drive is employed the speed may be adjusted to a nicety and the highest production of satisfactory work obtained. This possibility of increased production is, in many instances, so great as alone to justify fully the installation of individual motors on all the presses in a printing establishment, even were there no other advantages to be gained.

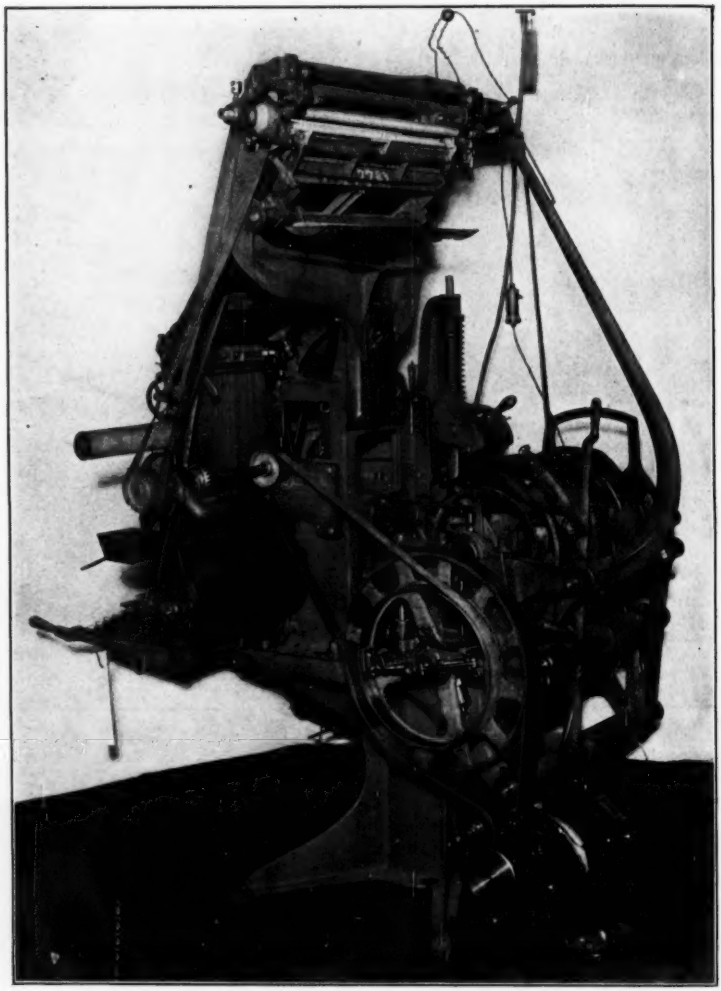


TYPICAL INSTALLATION OF ELECTRIC MOTOR FOR DRIVING A PRINTING PRESS.

A, controller; B, motor; C, main switch; D, fuse block; F, resistance box; G, belt-tightener pulley; H, tension spring governing belt-tightener pulley; I, carriage holding pulley; J, bracket on which motor is mounted.

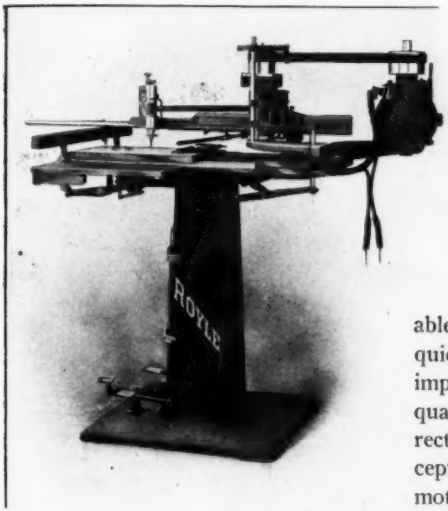
A motor may usually be attached to a press in such a way that there is no belt above the feed board, and moreover it may frequently be set into or under the frame so that it does not take up valuable floor space. Again, the elimination of vertical and overhead belts removes a source of danger, especially when female operatives are employed. Many serious accidents have happened through the dresses of female employees catching in the belts or on the shafts or pulleys and thereby drawing the wearers into the machinery.

Printing presses as well as other machinery, when equipped with motors, may be placed in such location in regard to light, air, and sequence of operations to be performed as to obtain the best possible results. Where the belt drive is relied on the presses must be lined



ELECTRICALLY OPERATED LINOTYPE MACHINE.
Motor made by General Electric Co., Schenectady.

up in reference to the line shafts, and there is little flexibility in location. Everything being considered, elevators may be operated more advantageously by electric motors than by any other means. Especially is this the case when the severe requirements of the modern "sky

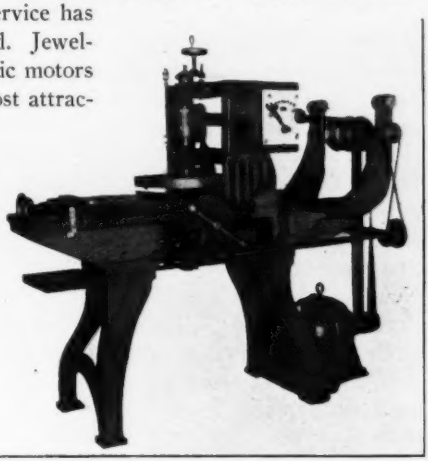


ROYLE ROUTER DRIVEN BY SPRAGUE VERTICAL MOTOR.

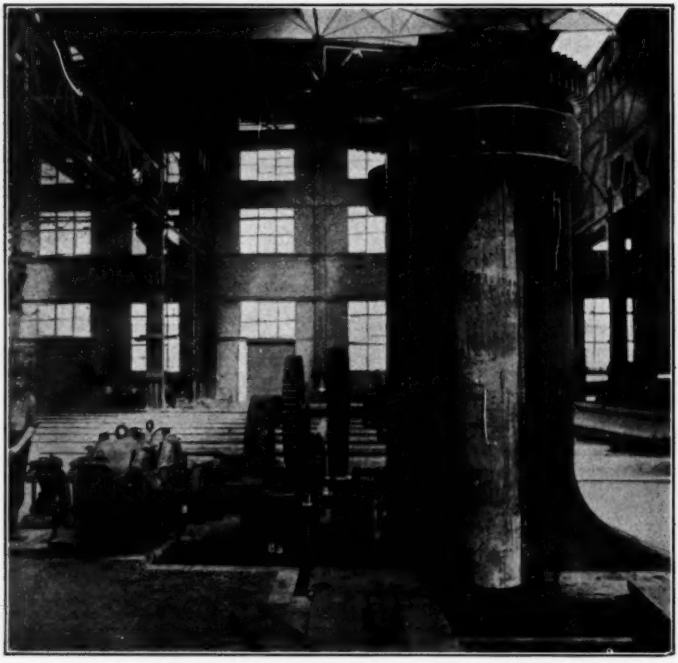
scraper" are considered. The tenants in such office buildings, comprising from ten to twenty or more floors, must be afforded rapid transit; and the elevator cars must be under perfect control in stopping and starting and in speed. They must be able to pick up headway very quickly, and it is well-nigh impossible to obtain an equal quality of service in these directions with any system except one employing electric motors. The expense of operating such elevators is also, usually, less than by any other method which will realize equally satisfactory results.

The use of the electric motor enables proprietors of stores and markets to operate coffee grinders, meat choppers, etc., by power where heretofore this laborious service has had to be performed by hand. Jewelers and opticians find electric motors furnish the cleanest and most attractive power supply possible to obtain.

The electric motor finds a particularly useful application in shipyards and erecting works, in conjunction with various machine tools which may be carried to different portions of the erecting floor or yard, and there the piece to be wrought may be machined in



2-HORSE-POWER SPRAGUE MOTOR BELTED TO WESEL DANIEL PLANER.

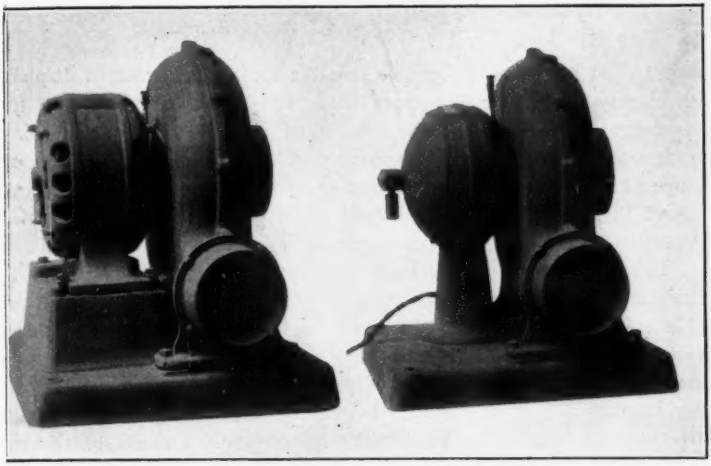


HEAVY VERTICAL STRAIGHTENING OR BENDING ROLLS DRIVEN BY TWO 50-HORSE-POWER WESTINGHOUSE ALTERNATING-CURRENT MOTORS.

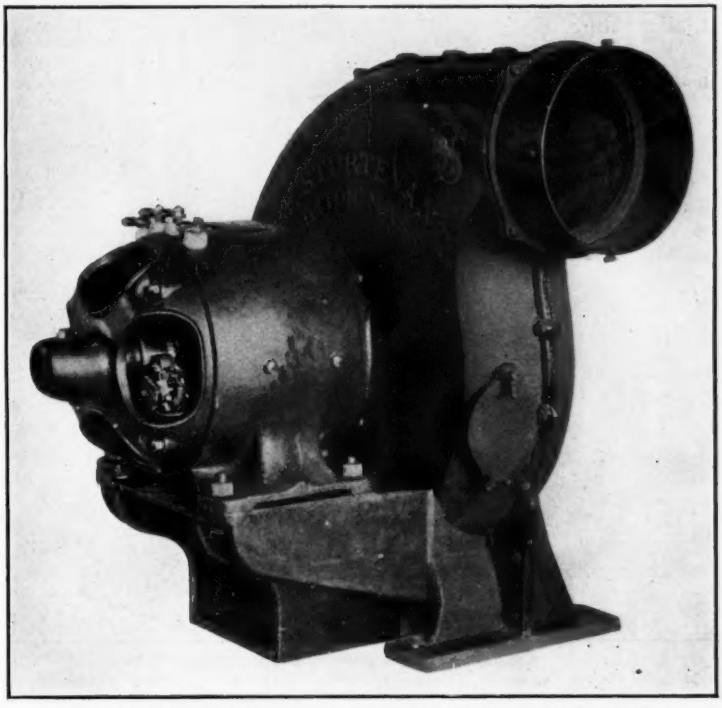
New York Ship-Building Company, Camden, N. J. Tool by Bement, Niles & Co., Phila.

place. This saves a great deal of transportation of heavy material, and the extent to which modern ship and bridge yards are equipped with electric motors is surprising. For operating portable emery grinders, forges, drills, and similar machines, the electric motor is particularly adapted. The large ship-yards at Newcastle-on-Tyne in England employ hundreds of motors, and the larger ship-yards of the United States are not at all behind them in this respect. At the yards of the New York Shipbuilding Co., the Newport News Shipbuilding Co., the Fore River Engine Co.'s works, and elsewhere, motors are very extensively used, for portable tools and for driving machinery in the shops.

On shipboard electric motors displace donkey engines. They are much more compact, dispense with the labor of special engine runners, and are not nearly so liable to break down or to fail at an inopportune time. It is quite safe to say that the larger number of fans and exhausters installed at the present time are equipped with electric



1/15-HORSE-POWER GENERAL ELECTRIC MOTORS DIRECT-CONNECTED TO CANEDY FORGE BLOWERS.

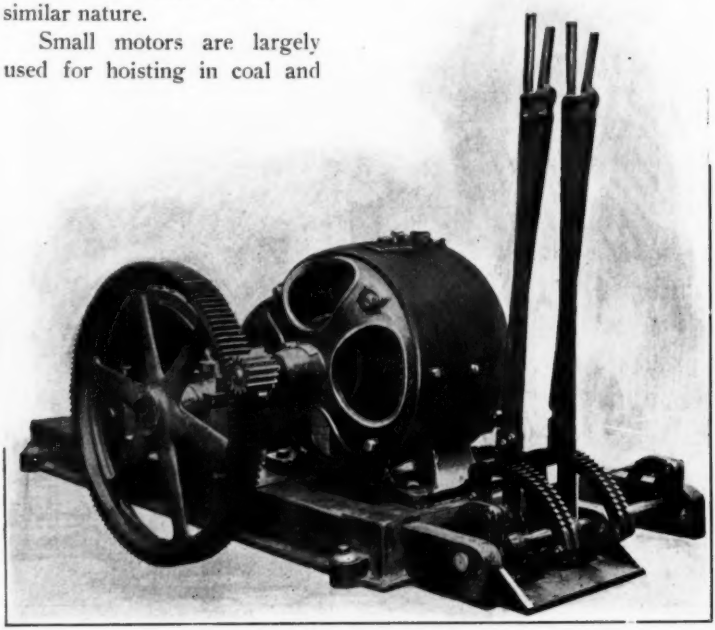


GENERAL ELECTRIC MOTOR DIRECT-CONNECTED TO STURTEVANT BLOWER.

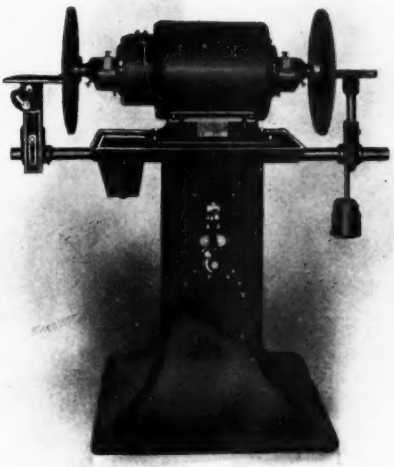
motors. It has recently become possible for a blacksmith to displace his clumsy bellows by a compact little outfit which furnishes blast for his forge while he attends to other duties. The wholesale clothing trade consumes an enormous number of motors in a year. A very large percentage of sewing, button-hole, and other similar machines derive their power through the unobtrusive little machine, which in construction is so simple, and in operation so quiet and reliable.

Bakers and confectioners find no method of supplying power to their mixing, kneading, and stamping machinery so cleanly or desirable as the electric motor. In large hotels, like the Waldorf-Astoria, motors are very extensively used in the kitchen and steward's department for polishing and cleaning silver, chopping and grinding, operating laundry and knife-cleaning machines, ventilating fans, ice-cream freezers, ice crushers, and bread-mixing machines. Motors, with extended shafts on which swabs may be mounted, are also used for cleaning pitchers, syrup jugs, carafes, and other articles of similar nature.

Small motors are largely used for hoisting in coal and



ELECTRICALLY OPERATED PORTABLE HOIST.
Made by Denver Engineering Co.; equipped with motors made by General Electric Co.



DISC GRINDER DRIVEN BY STOREY MOTOR.

other mines; it is often necessary to sink short shafts from one level to another while exploratory or developmental operations are going on. A self-contained electric hoist, operated by a 1-horse-power motor, may be carried from place to place by two or three men, set up very quickly, and will handle as much material as the number of men working in a small breast can take out. The larger motor-driven hoists for mining operations have been very largely used for several years.

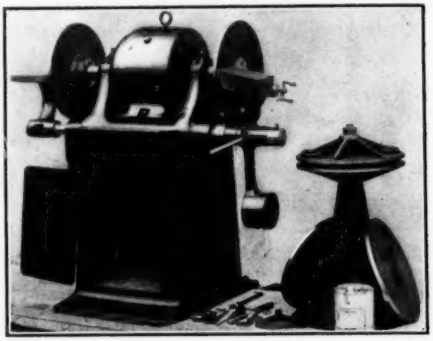
Most of the cash-carrier systems in large retail stores are operated by electric motors. Manufacturing druggists find them of great utility and convenience in operating mechanical filters, lozenge and pill machines, drug grinders and mixers; while one of the latest applications is embodied in an ingenious motor-driven candy puller, which not only does its work in a far more satisfactory and cleanly manner than it can be done by hand, but which—when displayed in a show window—is a source of never-ending interest and attraction to passers-by.

Motor-generator sets are in wide demand, not only for the charging of storage batteries in automobiles and launches, but also for displacing the wasteful, expensive, and troublesome primary batteries of telephone and telegraph systems.

Small motors have recently been used to lighten the work of typewriters. They are so applied to these machines as to do all of the real work of striking the type bars, etc., in response to a light touch on the keys of the key board. Typewriters arranged with these motors are very attractive. Bottlers of aerated and mineral waters find uses for motors to operate their bottle cleaners, wiring machines, sterilizers, and washers. They also employ them for operating pressure pumps, carbonating machines, and similar apparatus.

The silk mills in Italy and France use a very large number of

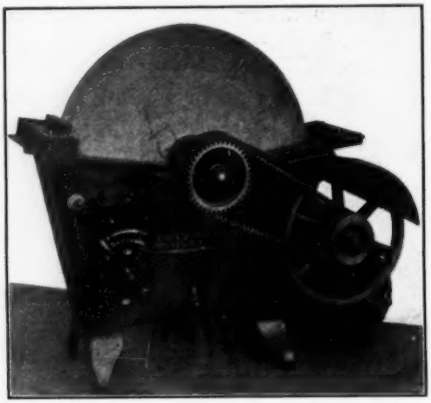
motors ranging in power from ½- to 1-horse-power for driving their ribbon and other looms. These motors are usually alternating-current machines and have been found most successful. The Susquehannah Silk Mills at Sunbury, Pa., and Marion, Ohio, the Royal Weaving Co. of Pawtucket, R. I., and a few other mills in the United States have been partially equipped with such motors, and their use is growing rapidly. Motors are also largely used in knit-goods factories. Braiders, button machines, knitting machines, and sewing machines are all found to operate more satisfactorily when driven by motors than when operated otherwise.



RANSOM 18-INCH UNIVERSAL DISC GRINDER, DRIVEN BY AKRON MULTIPOLAR COMPOUND-WOUND MOTOR.

An enormous volume of water is pumped, not only in private houses but in mills, factories, and even in city water works, by electrically operated pumps.

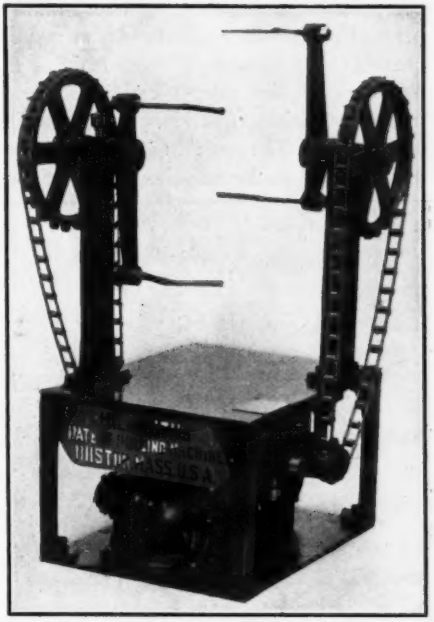
The modern overhead crane, which is such a useful adjunct to machine shops and foundries, would be impossible in its perfection were it not for the electric motor.



BROWN & SHARPE GRINDSTONE DRIVEN BY BULLOCK MOTOR.

One of the latest applications of motors now being developed is in connection with lumbering in the great forests of the Northwest and elsewhere. Portable saw mills with saws mounted on the extended shaft of motors are used. A portable generating plant which may be relocated

from time to time supplies the needed current and, instead of moving the logs to the mill, the mill is moved to the logs and they are sawed into lumber where they fell. The mill is easily moved about through the forest, and the wires leading back to the generators are looped from tree to tree. This method will effect enormous savings, as no waste wood has to be transported, and the smaller and more easily handled neat lumber only is carried out to the railway instead of the huge and unwieldy logs.

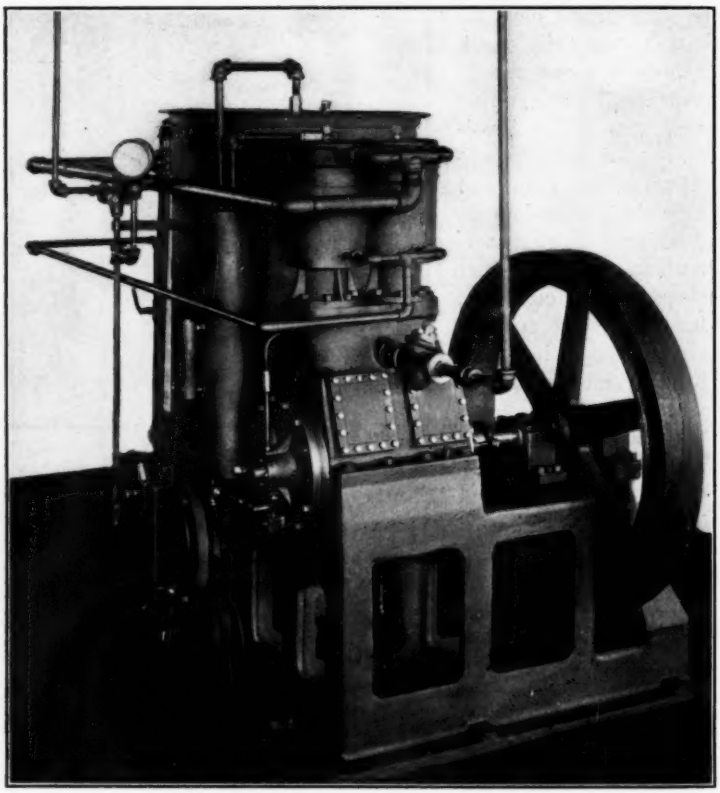


MOTOR-DRIVEN CANDY PULLER.

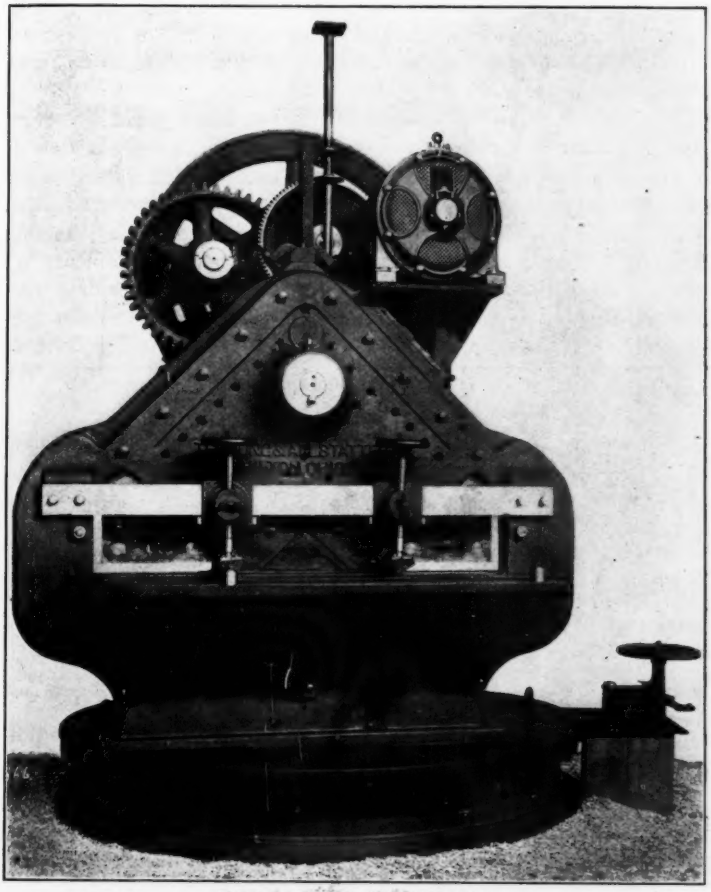
One of the most attractive uses for small motors is in connection with small refrigerating apparatus. The possibility of installing individual refrigerating and cooling machines in dwellings, dairies, restaurants, cafés, butcher shops, drug stores, etc., has long been appreciated. Many inventors have given their time for years to the attempted solution of the problem involved and much capital has been spent in experimentation. Until the development of the electric motor, a serious handicap was found in supplying power in small units for the operation of these machines. Gas engines, oil engines, small steam engines, water motors, and other prime movers were employed, but in each case the expense of maintenance, attendance, and repairs necessary, and the unreliability of the prime mover, were so great as to prohibit the successful exploitation of the system as a whole. The modern small motor, supplied from the mains of central stations, is admirably adapted for furnishing the power required, and within the last few years a great impetus has been given toward the perfection of refrigerating and cooling machines. It will undoubtedly soon be possible to procure commercial automatic refrigerating apparatus

capable of making from 100 pounds to 5,000 pounds of ice in 24 hours, the refrigerating duty of each of these machines being, in general, twice as great as its ice-making capacity.

The apparatus consists, essentially, of a pump for compressing ammonia or sulphur dioxide, a cooling coil for abstracting the heat of compression, a regulator for controlling the admission of the compressed gas to the cooling coils, an expansion coil within the cooling chamber, and a return system of piping to the pump mechanism. The machines require motors ranging from $^1/_6$-horse-power to 5-horse-power, and the operation of the machines is, of course, practically continuous. The regulation of the degree of refrigeration produced has, aside from the question of power, been the most serious one that



MOTOR-DRIVEN AUTOMATIC REFRIGERATOR MACHINE.



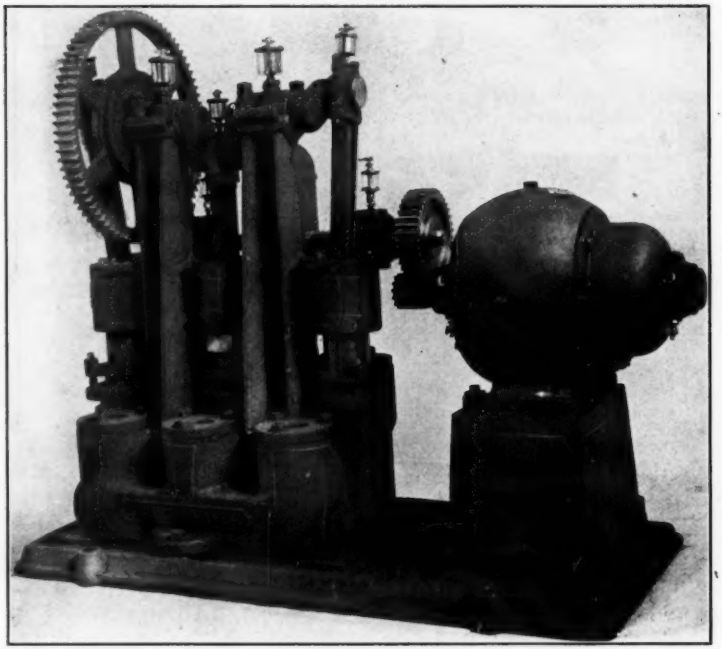
ELECTRIC-DRIVEN ANGLE SHEARS.
Long & Alstatter Co., Hamilton, Ohio; Westinghouse alternating-current motor.

inventors have had to face; it is comparatively easy to effect regulation when any specific duty is to be continuously performed by such a machine, but when the demands are variable, or when a machine is called on to make ice and reduce the temperature in a cold room, and perhaps to supply cooling coils for an air system at the same time, the question of regulation becomes a most serious one.

Within the past two years great progress has been made in methods of regulation, however, and by means of ingenious electrical mechan-

ism, the circulation in the various coils can be controlled to a nicety. As these machines can be built for a moderate price, we may expect to see a very large sale for them in the near future and this will still further extend the field for the sale of motors.

The cost of refrigeration under this system is not prohibitive even when electricity is supplied from coal-burning stations. In a certain installation which was visited recently, it was found that a machine of 1-ton nominal capacity, operated by a motor of 3-horse-power nominal rating, was furnishing refrigeration for a storage room 25 feet by 15½ feet by 8 feet, and a delivery chest 20 feet by 1 foot 8 inches by 6 feet, at an expense (as given by the owner) of $1.00 per day—the average temperature obtained being 42 degrees. Of this one dollar, 56 cents was expended for electricity and 44 cents for water. The current

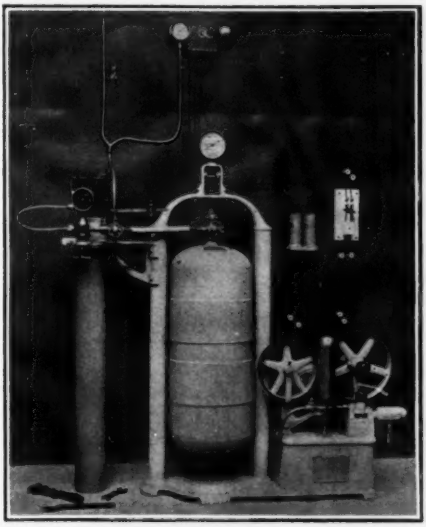


ENCLOSED DIRECT-CURRENT MOTOR GEARED TO TRIPLEX PUMP.
Northern Electrical Mfg. Company's 5-horse-power motor. Smith-Vaile pump.

was supplied by meter at 3 cents per kilowatt and the water by meter at 12 cents per thousand gallons.

The proprietor of the plant was most enthusiastic in favor of the

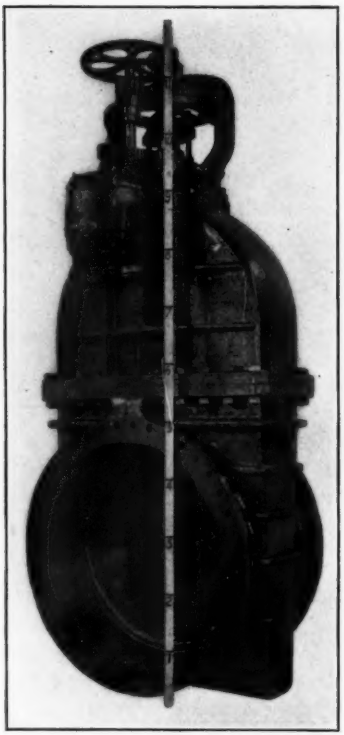
service obtained; the entire outfit cost him less than $1,000; repairs for eighteen months had been less than $5.00, and the saving over the use of ice had averaged $12 a week. He had been buying ice at what he considered a very favorable figure, viz., $3.00 a ton. In recommending the apparatus, he made a particular point of the freedom from interference with his customers by the iceman bringing in large quantities of ice every morning, and also freedom from the annoyance or drip, dirt, and sloppy floors. It will be observed that his saving of $12 a week would more than pay for the entire installation in two years. In the southern States and in tropical countries, where ice costs from $12 to $25 a ton, artificial refrigeration, on a small scale, even with electricity at 8 and 10 cents per kilowatt, is entirely practicable.



½-HORSE-POWER MOTOR DRIVING CARBONATING APPARATUS.
Lippincott Co., Philadelphia.

Before leaving this subject, we may touch briefly on the application of motors to the manufacture and dispensing of temperance beverages; in other words, let us see what a valuable adjunct the electric motor has become to the modern soda fountain. Formerly, the aerated water necessary for use in soda fountains was prepared at some point where heavy compressors and other machines were available, and this aerated water, under a pressure of several atmospheres, was distributed at frequent intervals to every soda fountain in the well-known, blue-painted, steel tanks, or the more expensive copper ones. In the outlying districts, the express charges on these tanks of water were very considerable, and if the supply did not come promptly to hand, much annoyance was experienced.

Recently, ingenious machines known as "carbonators" have been devised which enable each owner of a soda fountain to produce a supply of carbonated water on the premises, as used. These carbona-



3-HORSE-POWER SLOW-SPEED MOTOR OPERATING 50-INCH CHAPMAN STEAM VALVE.

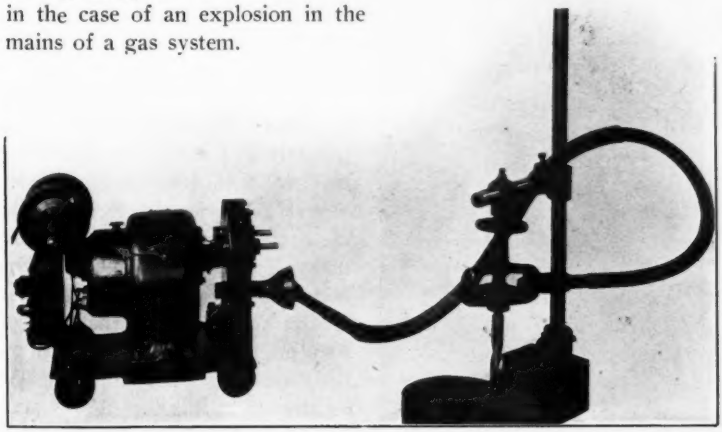
tors are almost universally driven by electric motors. The carbonating apparatus is simple, automatic, and costs very little to operate. A druggist or confectioner, therefore, who can obtain an electric-current supply, may now provide himself with the apparatus for producing his aerated water and a refrigerating machine for keeping his fountain cold, both pieces of apparatus being driven by small electric motors, under perfect control. With such an installation he is entirely freed from dependence on the manufacturers of aerated water, the transportation companies, and the ice companies.

Hospitals, also, find refrigerating machines of the utmost utility in connection with modern therapeutic and surgical practice. On the whole, it seems as though there was no other single unexploited field which offers greater opportunities for the sale of motors and current than in connection with small cooling and freezing machinery.

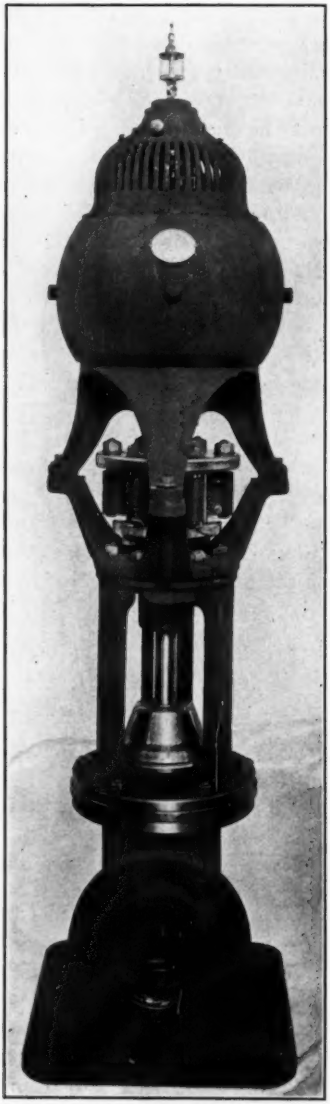
The problem in operating steam, exhaust, and water valves in large central stations and in connection with gas and water-supply systems has always been a difficult one. It is extremely desirable to be able to control large valves from a distance. In electric light and power stations the control of certain valves from the main switchboard is of prime importance. In the distribution of water and gas the control of section valves from a distance is equally desirable. Systems of rope and wire transmission have been employed with but indifferent results. The same is true of air and hydraulic control. A valve properly equipped with a suitable electric motor, however, enables the problem to be solved readily. By the use of such valves as those

figured in the illustrations, complete control of the movement of the fluids circulating through pipe lines may be readily obtained from one or more distant points. A 50-inch valve will in general require the efforts of five or six men twenty minutes to open or close it, whereas with an electric motor the same work may be done in three minutes or less. In cases of explosion or break-down in power stations the escaping steam often fills the building so that section or other valves cannot be approached by the employes in an endeavor to shut or open them; consequently, the whole station apparatus comes to a standstill and nothing can be done until the building is free from steam. If electrically operated valves are used and the control is arranged at two or more stations, the valves may often be manipulated, even while the building is full of steam, so as to enable a portion of the machinery, at least, to be kept in operation. This very valuable feature is becoming more and more prominent as stations are increased in size and output.

Again, the use of electrically operated valves in gas or pipe distributing lines would often prevent immense damage. In the winter, for instance, if a large water pipe bursts in the night, it may take considerable time to get the men out to shut the section valves; the ground may be frozen and the valves almost inaccessible. If such important valves were controlled from the water company's office, immediately notice of trouble was received, the section gates could be closed without disturbing anyone and further damage stopped. The same is true in the case of an explosion in the mains of a gas system.



1-HORSE-POWER GENERAL ELECTRIC MOTOR DRIVING PORTABLE DRILL THROUGH FLEXIBLE SHAFT, MADE BY STOW FLEXIBLE SHAFT CO., OF PHILADELPHIA.

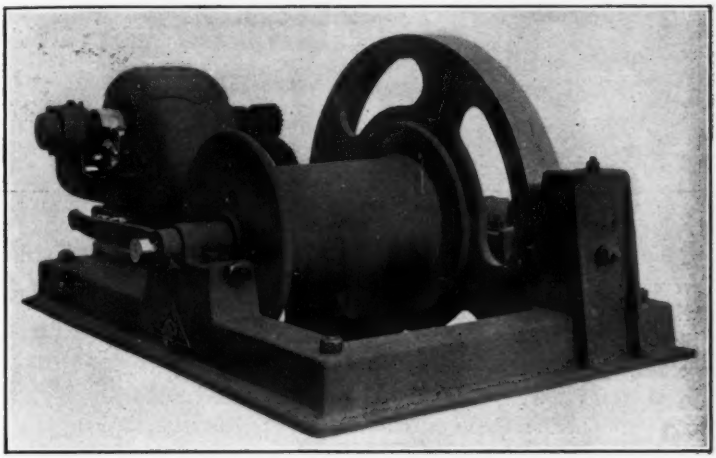


NORTHERN VERTICAL 5-HORSE-POWER MOTOR OPERATING WOOD PROPELLER PUMP.

Makers of domestic laundry machinery have lately become interested in the use of motors, and it is now possible to equip a moderate sized house with washing machine and mangle at comparatively small expense. In England, and on the Continent, mangles are very largely used, but they are not much known in the United States outside of hotels. For all plain ironing, such as sheets, pillow cases, towels, etc., in the household, they do very satisfactory work. Ironing, as ordinarily carried on in New England at least, is a very laborious task. By means of a mangle driven by a small motor, however, a large part of the family ironing may be done in a very short time and in a very acceptable manner. A washing machine may be operated by the same motor and, so far as what are ordinarily known as "plain clothes" are concerned, its operation is very satisfactory.

A field which has recently been exploited with much success, particularly in the western States, is that of furnishing motor-driven electric hoists for the use of building contractors. Owing to strikes, many building operations have been tied up; the contractors looked about to see what means they might adopt for overcoming the losses, annoyances, and delays incident to having their hoists and engines out of commission; the electrical people were very glad to

assist, and the result has been that some contractors are now using electrically operated hoists, electrically operated pumps, and will undoubtedly also use conveyors and loaders for bringing the material excavated from cellars up to the teams at the street level. No license is needed to enable a man to operate such a machine and this line of business is capable of vast expansion. The success attending the use of motors for hoisting, pumping, and conveying has led other more

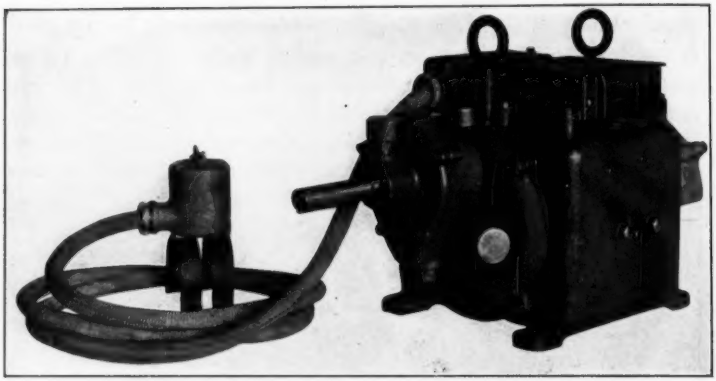


MOTOR-DRIVEN HOIST.
Denver Engineering Co. and General Electric Co.

progressive contractors to install electrically operated saws and similar machines in large buildings under construction, where there is a good deal of wood work to be done; a great deal of time may thus be saved in sawing sheathing and other finish to definite lengths, cutting mitres, etc. Electrically operated pipe-cutting and threading machines may also be used to excellent advantage in similar cases. There appears to be a wide field for central stations to exploit this class of current supply with profitable results.

Building contractors are also beginning to displace by motor-driven machines the slow and laborious hand process of grinding and polishing mosaic floors. Machines which look something like lawn mowers are built in Oakland, California, and in Philadelphia, Pa., for planing and surfacing hard-wood floors. They are said to be eminently successful in operation.

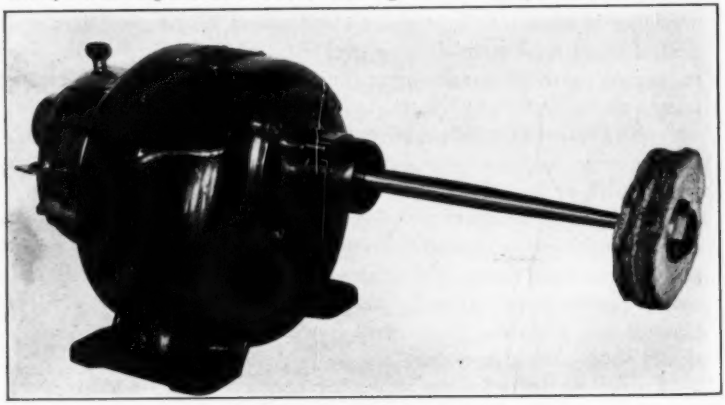
Pneumatic drills for use in mining operations are, in many localities, being displaced by motor-driven mechanical drills. The expense



MINING DRILL OPERATED BY CONTINUOUS-CURRENT MOTOR.
General Electric Co.

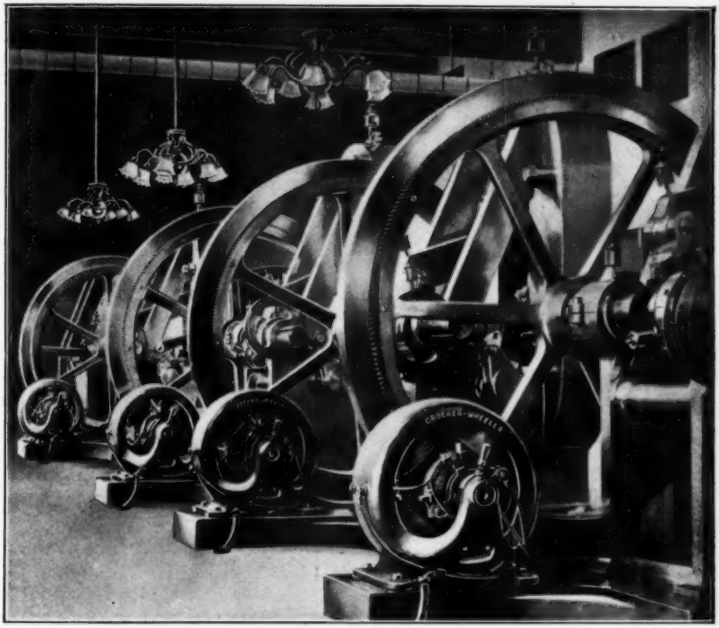
of operation is said to be very much less than that of the air drills and, were it not for the fact that, in many mines, the supply of fresh air which comes from the drill exhaust is absolutely necessary for ventilation, the electric drill would undoubtedly distance its older competitor.

It is of the utmost importance to users of electric motors that the machines purchased be not only of high efficiency, in order to insure minimum charge for the current used to operate them, but of the proper size and winding to perform the work in hand. While it is always well to purchase a motor having a small margin of power above



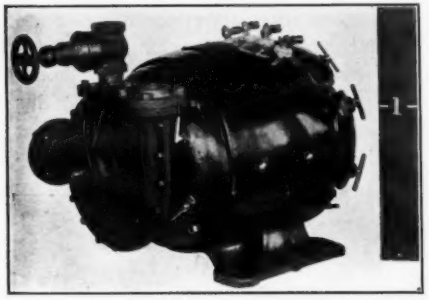
MOTOR-DRIVEN BUFFING MACHINE.
General Electric Co., Schenectady.

the actual requirements, it is not desirable to buy one much larger than is needed unless additional load is to be taken on in the near future. The best motors are so designed that they possess maximum efficiency for continuous operation at their normal rated output, and it should be the aim of the purchaser so to subdivide the grouping of his machinery that the motors in use may be as far as possible operated at their maximum output when running at all.



GROUP OF COINING PRESSES IN THE UNITED STATES MINT, DRIVEN BY 7½-HORSE-POWER CROCKER-WHEELER MOTORS.

In equipping a factory a number of machines will often be found which are used only intermittently. As a rule it is not desirable to drive such machines from motors that are operating machinery continuously, for, if this be done, then during certain periods—when the intermittently used machines are idle—the motors will be running at partial load only and at a point much below their best efficiency; and during a portion only of the time, when the machines intermittently used are at work, will the motors be carrying their full load and doing their work in the most economical manner. In cases where a mixed

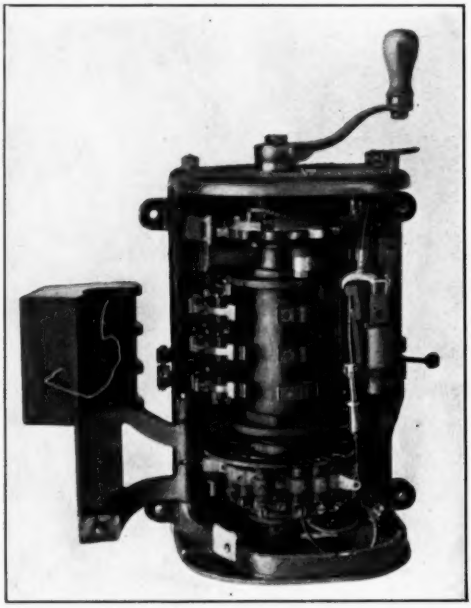


CENTRIFUGAL PUMP DRIVEN BY GENERAL ELECTRIC MOTOR.

load must be carried, it is desirable to split the drive, so far as possible, and use two or more motors—one for driving the continuously operated machines and the other for driving those which are intermittently used. In this way each motor may be worked at its best efficiency when it is working at all, and a large saving in current bills will result. It will often be found desirable and financially profitable, everything considered, to equip intermittently operated machines with individual motors, and this is especially true if variable speed is required.

A failure to exercise due care in selecting the type of motor for the work in hand has often resulted in the inability of the purchaser to obtain that satisfaction from an electrical drive which may always be obtained when proper motors are chosen.

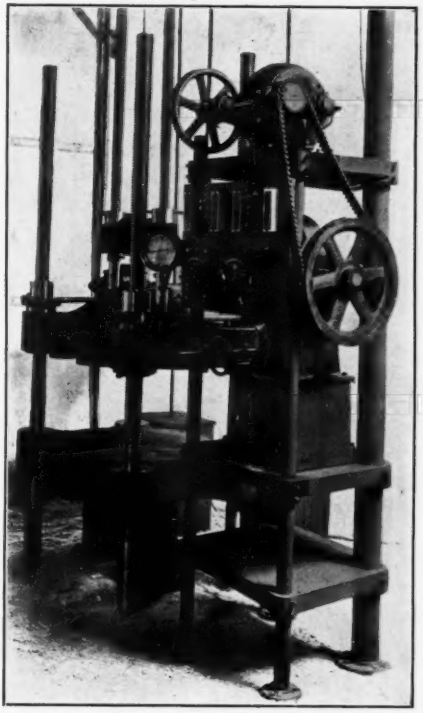
It is a comparatively easy matter to show what the financial aspect of small saving in motor efficiency is, and for those who are unfamiliar with the method of working out a comparison the following illus-



CONTROLLER FOR VARIABLE-SPEED MOTORS.
General Electric Co.

trations are given: a 5-horse-power motor operated at three-quarters load with an efficiency of 84 per cent., when compared with another motor operated at three-quarters load with 79 per cent. efficiency, shows a very considerable saving. Assuming that these motors are in operation 3,120 hours per year and that the charge for current is 6 cents per kilowatt, we find that there would be a saving in favor of the higher efficiency motor of $39.50 per year. This result is arrived at as follows:

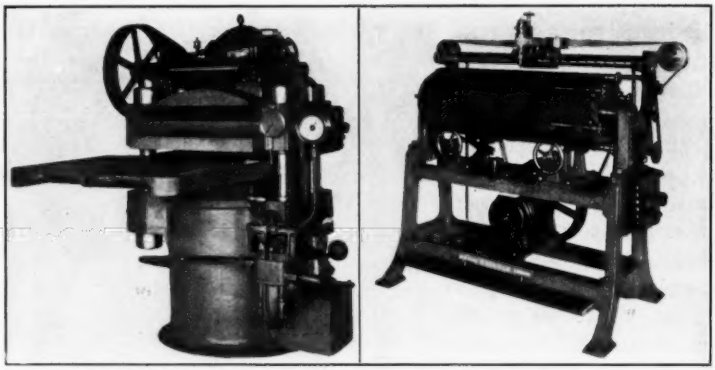
If the motors had an efficiency of 100 per cent., they would consume five times 746 watts, or 3,730 watts at full load; three-quarters of this would be 2,798 watts. Their efficiencies being, however, 84 per cent. and 79 per cent. respectively, they will actually require 3,330 watts and 3,541 watts applied at the terminals, the saving in favor of the higher efficiency motor being 211 watts. 211 watts at 6 cents per kilowatt for 3,120 hours will amount to $39.50.



HYDRAULIC ARMATURE PRESS ACTUATED BY ELECTRIC MOTOR.

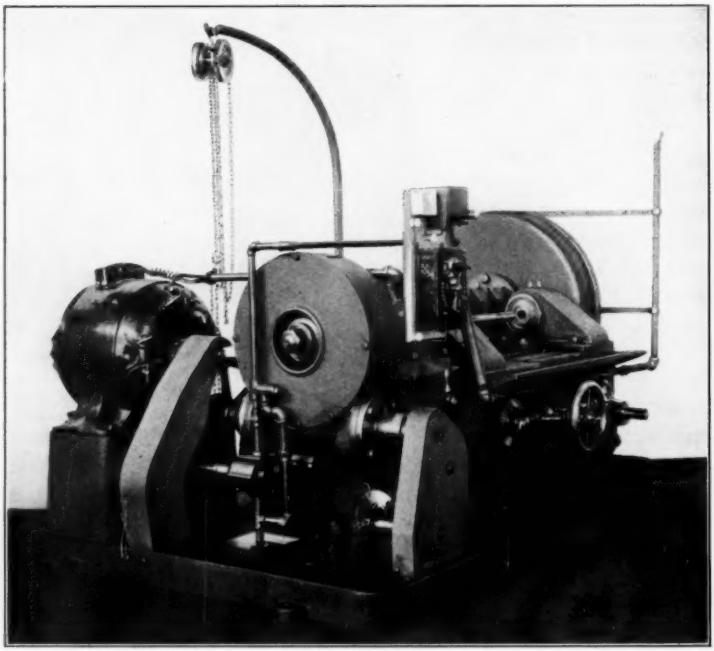
The 3-horse-power Northern motor at the top drives the pump (concealed by the switch panel) through Renold silent chain. The motor just seen over the upper head at the left accomplishes the travel of the head, saving much blocking of work.

While this sum in itself is not large, in ten years—which is the conservative life of a motor—the excess of energy required for the machine with the lower efficiency would amount to $395.00. This is more than twice what a first-class high efficiency motor would cost to begin with. In other words, there would have been sufficient savings in about six months to have paid the difference between the high and low efficiency machines at the start; and at the end of ten years the

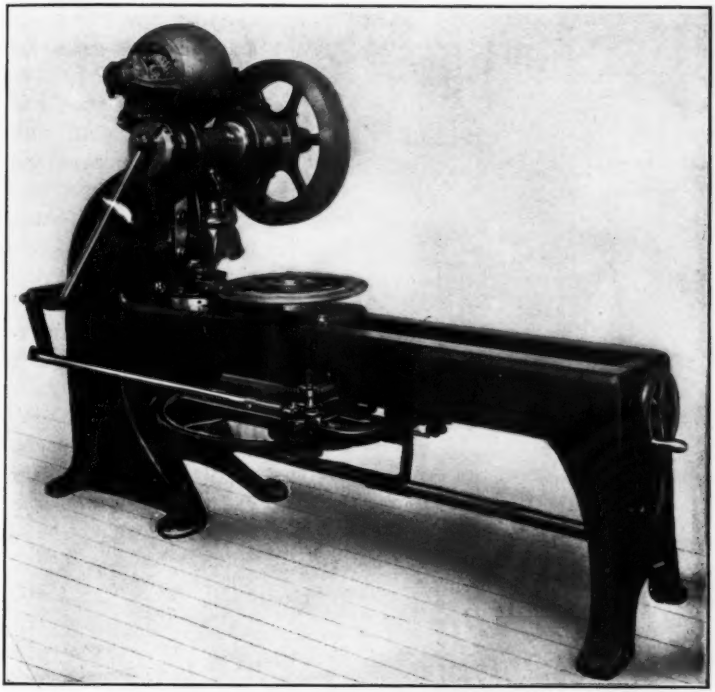


MOTOR-DRIVEN HYDRAULIC MOULDING PRESS AND CURVED ROUTING MACHINE.

R. Hoe & Co. and Sprague Electric Co.



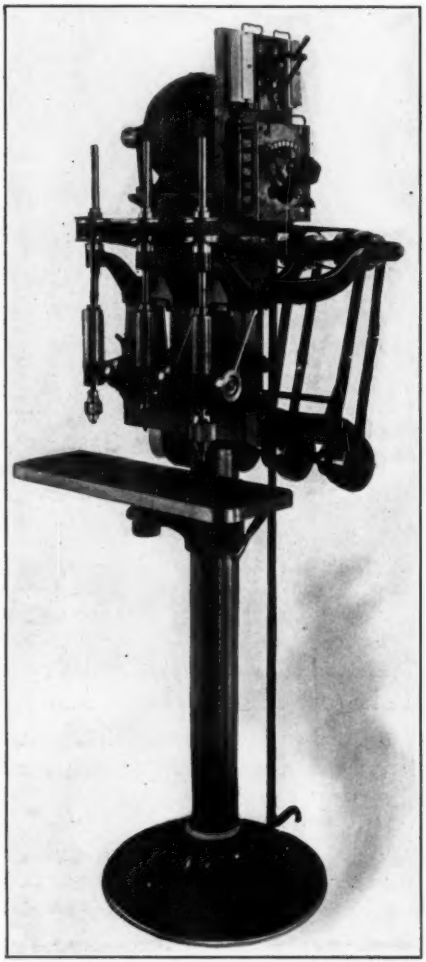
NILES HORIZONTAL GEAR MILL DRIVEN BY GENERAL ELECTRIC MOTOR.



5-HORSE-POWER NORTHERN MOTOR GEARED TO FERRACUTE NOTCHING PRESS.

owner would have saved about $375 in his current bills, had he bought the better motor and paid $20 more therefor. $375 saved in ten years represents annual savings bank interest on a deposit or capital of more than $1,000. It is certainly far easier for a motor buyer to secure for himself an income of $37.50 a year by saving what otherwise would be wasted, than to take $1,000 or more out of his business for deposit in a savings bank, in order that he may enjoy the same income per year therefrom. It is only by the liberal use of material and careful designing that low heating and high efficiency in a motor can be secured, and it is always desirable to pay the slightly increased price for such a motor rather than to purchase a light-weight machine, whose appetite for electricity is, and always will be, rather expensive to satisfy.

In addition to satisfying oneself that the motor selected for purchase is of high efficiency, care should be used to select



NORTHERN ELECTRICAL MFG. CO.'S MOTOR DRIVING SIGOURNEY THREE-SPINDLE SENSITIVE DRILL.

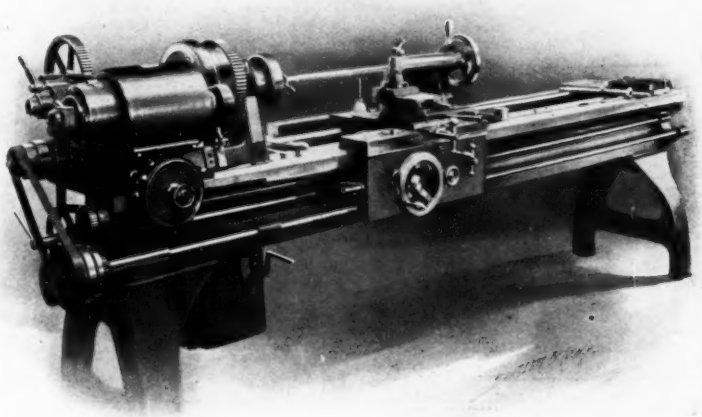
Shown by mistake as Bullock equipment in a former issue.

one that is well designed and sturdy in construction.

The frame should be substantial and of such shape as to enclose and protect the windings, commutator, and brush mechanism from mechanical or other external injury. The bearings should be long, easily renewable, and the oiling arrangements so fashioned as to insure a copious and continuous oil supply without leakage or spattering. The armature shaft should be of ample size with moderately long journals carefully ground to size. There should be sufficient stock in the shaft so that there will be no bending or springing even under heavy overloads. The segments of the commutator should be of generous depth and particular attention should be given to the quality of mica used in its insulation and the means for holding the segments together. The commutator is the most delicate part of the direct-current motor and if it be not of the best design, material, and construction, breakdowns are almost certain to happen sooner or later. Finally, the brush mechanism should be the subject of careful selection;

an elaborate design with multiplicity of parts and delicate adjusting screws and levers should be avoided. Simplicity, strength, and rigidity of parts while allowing flexibility of brush movement should be aimed for.

While a purchaser naturally desires an attractive, symmetrical machine, yet he should never be misled by polished brass and ornamental painting to overlook the absence of those real essentials upon the possession of which the satisfactory operation of an electric motor so largely depends.



LATHE WITH STOREY MOTOR AND ELECTRIC CO.'S EQUIPMENT.

Courtesy of Bernard Macdonald, Esq.

AN ALASKAN SUNSET OVER SEA AND MOUNTAIN.

THE GOLD-BEARING GRAVELS OF ALASKA.

By John D. McGillivray.

THE gold-bearing gravels of Alaska and the Canadian Yukon extend from the 130th to the 141st meridian on the Canadian side, and from the 141st to the 168th meridian of west longitude in Alaska, a total of 38 degrees, or over one-tenth way around the world at that latitude. North and south these gravels are found from about the 60th to about the 70th parallel. They are found along the Yukon river and most of its branches, and on the Kuskoquim, the Copper river, the Seward peninsula, and on streams running into Behring sea. What the actual area of these gravels may be there is no means of judging at present, and will not be for many years to come, because a large part of them are situated far in the interior at long distances from river transportation, and so will not attract the attention of prospectors or capitalists for some time. That they are far

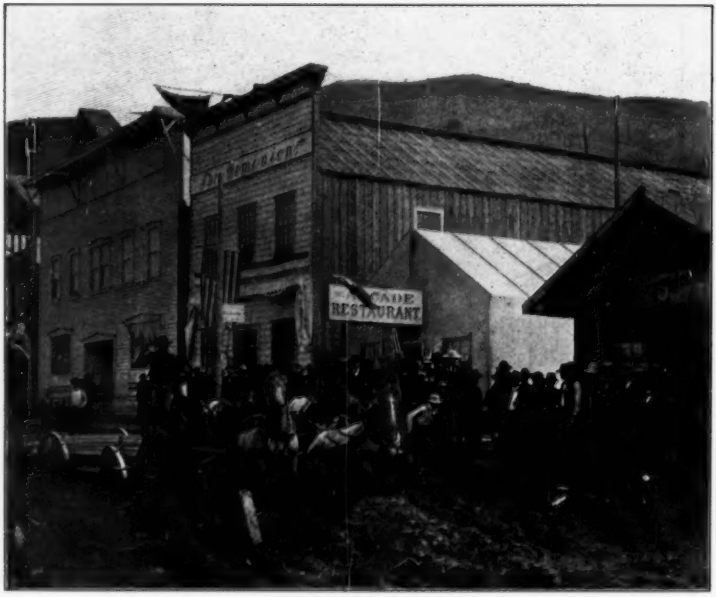
more extensive than were the gravels of California has been easily proved by the amount of ground already located. Up to December, 1898, there had been located in the Klondike district alone 35,000 acres, and since then locations have more than trebled that in this district and in the Stewart river country adjoining. In addition to this the Canadian government has granted concessions covering large areas of ground, much of which is of only problematical value, exceeding in area all the ground that has been located by the miners.

It may be said in favor of the values found in the Klondike gravels that they are being worked by very crude methods and without water under pressure, owing to the very shortsighted policy of the Canadian government. In fact, very little gravel in the Klondike country costs less than $2 per cubic yard to work.

PACKING UP THE CHILKOOT PASS, BEFORE THE DAYS OF THE RAILWAY.

In the Forty Mile district on the American side are several hundred miles of creeks along which creek and bench claims have been located. Owing to the stampede to the Klondike of 1896 and 1897 very little work has been done in the Forty Mile country until lately. Last fall something over 1,000 men, many of them with small capital which they had made by mining in the Klondike country, went over into the Forty Mile district to secure claims, either by location or by purchase. As a result it may be expected that this Forty Mile district, which

covers an area as large as the gravels of the Klondike country, will within two or three years produce a great deal of gold, part of it from claims worked by the old drifting method, and part of it from claims worked by the use of water under pressure, and by dredges or steam shovels. In the Seventy Mile country last summer I found stakes on every branch of that stream, and this meant many hundreds of 20-acre locations, and I examined some gravel owned by a company that has located a little over 4,000 acres along the Seventy Mile River itself. So it is in the Koyukuk country at the Arctic circle; so it is in the Birch Creek diggings near Circle City, and on the Tannana river, where there was a stampede last winter of several hundred miners from the Klondike and other districts, and in the Minook country, and at Nome and other points on the Seward peninsula. It may be said that a great deal better mining is being done at Nome than at most of the other points along the Yukon, simply because the cost of transportation of supplies is low there. On the Kuskoquim large areas of gravel that promised well were found by some expeditions that went in there in 1901. In the Copper River country some gravel



MAIN STREET OF DAWSON IN THE SPRING OF 1898.

THE HIGHER WHITE LINE IN THE BACKGROUND SHOWS THE BENCH GRAVELS OF GOLD HILL. THE CREEK TO THE LEFT IS ELDORADO. IN THE FOREGROUND ARE THE CREEK CLAIMS OF BONANZA. $20,000,000 WERE PRODUCED FROM THE AREA SHOWN.

mining has been done during the past two years, but most of the men in there are naturally attracted to the copper deposits. I would suggest to any one interested in this matter of gravel to look over the reports of the United States Geological Survey, covering a large part of Alaska, where it will be seen that gold-bearing gravels are nearly always found in large areas all over Alaska.

In any one of these districts which I have named capital can at small cost secure large areas of gravel, from 100 acres up to 1,000 acres or more, to be worked by the ordinary hydraulic method, or with dredges or steam shovels and under favorable conditions. It must be remembered that the lodestone that has attracted the attention of the world to that part of the north is Eldorado Creek in the Klondike country. Eldorado has been worked out, and yet the output of the Klondike is as large as ever, and this output comes from the lower grades of gravel that would not have paid profits under the conditions existing a few years ago.

What I would take as a text for this article is that there are far larger areas of gravel, and as rich in values, on the Alaskan side, from the 141st meridian to Nome and beyond on the north, and to Valdes

THE YUKON BELOW DAWSON.

and to the mouth of the Kuskoquim on the south, than on the Canadian side; and that this gravel may be taken up under more favorable mining regulations, but that the reason why the gravels have not been developed by capital is that the cost of transportation of supplies has been so high. This difficulty can be remedied by capital or by the Federal government in a very inexpensive way, as I shall show later.

The product of gold from Alaska of late has been as follows:

1898	$2,820,000
1899	5,125,000
1900	7,531,835
1901	6,904,000

For the year 1902 the production of gold from the Nome district alone was $5,050,000. What the output of the rest of the country has been I have no means of learning; but this I do know, that into the Forty Mile district, the Seventy Mile, the Tannana, the Koyukuk, and other districts, have gone many experienced miners, mostly without capital, who will do much either toward directly developing those various districts or toward interesting capital in the opportunities that may be found in them.

As I have said, into the Forty Mile district alone have gone during the past year over 1,000 miners, many of them with small capital, from the Klondike country. Several hundred have gone into the

Tannana country, not only from Dawson, but even from the outside over several hundred miles of snow-covered winter trails. It is probable that the mining population of Alaska will be this summer double what it was last summer. However, I do not anticipate a very large increase in the output of gold, for most of these men being without capital will do little more than secure properties to work next season. Quite a number are men who are connected with capital and have gone in with a view of securing property to be placed on the outside.

Next year should show a considerable increase in the yield of gold, for several outfits with capital are preparing for large operations. In the Seventy Mile district on some properties that I examined last summer, the owners (who are London and New York capitalists) are preparing to expend nearly $300,000 for the purpose of bringing in water under pressure of about 200 feet to work several hundred acres of gravel that they own. In the Birch Creek country, John Gregor has put up a steam shovel to work Mammoth Creek. Similar large operations are being undertaken in nearly all the districts now, and this marks a new era in mining in the north—a change from old crude methods to newer and cheaper methods.

The product of gold from the Klondike region during the past three years has been as follows:

THE TWO MEN TO THE RIGHT ARE STARTING ON A 1,600-MILE ICE JOURNEY FROM DAWSON TO NOME.

1899	$16,000,000
1900	22,275,000
1901	18,000,000

During the year 1902 the output was probably about as much as it was for 1901, but the change in the royalty from a direct tax on the output to a tax on the export of gold made the figures appear considerably smaller, and as a result the reports made by the United States authorities and the Canadian government show only about $18,000,000. The last press despatches from the Klondike show that the output for the present season will be about $20,000,000. This will make a total output of the Klondike region—a very small area within about thirty miles of the town of Dawson, and all on one side of it—with what was taken out previous to 1899, about $100,000,000. This

THE GOVERNOR-GENERAL AND LADY MINTO WATCHING A CLEAN UP FROM BENCH GRAVELS.

Lord and Lady Minto are to the left of the author, who holds the pan.

gold was produced by miners without capital. A few companies have gone in there, but what they have produced is a trifling portion of the whole. The mines that are now being worked at a profit are mines which three or four years ago would not have paid at the costs then existing. Few of the mines being now worked at a profit could have been worked two years ago. The total output of the Klondike region

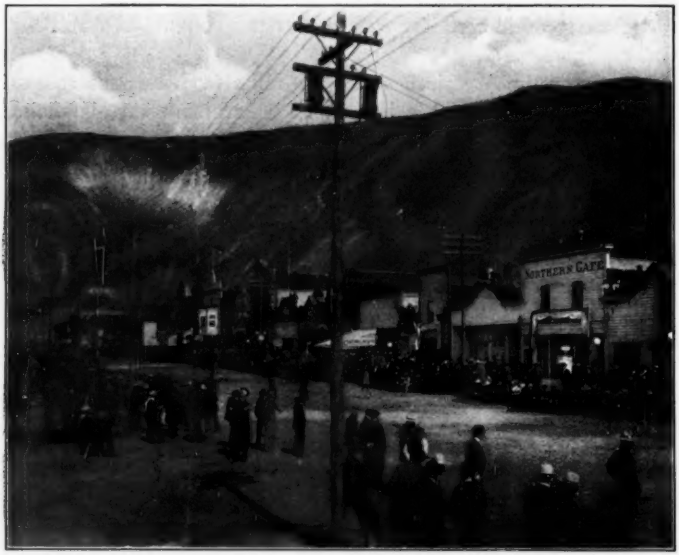
near Dawson will certainly exceed $300,000,000 and probably will be much larger.

Down on the American side a few miles from Dawson comes first the Forty Mile district, where there is available an abundance of water for hydraulicking and good dumping facilities and other conditions favorable for capital to work on large scales. The season during which hydraulic mining can be carried on is a little over four months.

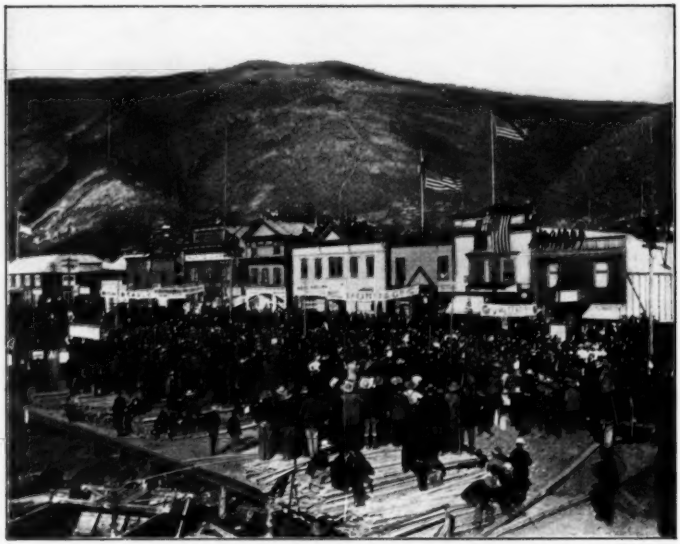
DOWN THE YUKON ON A SCOW.

The same conditions exist in the Seventy Mile, Charlie River, Birch Creek diggings, the Koyukuk country and at the Minook and on the Tannana. In each one of these districts are large areas of gravel, sometimes as much as 1,000 acres, contiguous and to be acquired as one property, with good dumping facilities and with water in the neighborhood available that may be brought on with pressure of from 100 to 200 feet above bed rock in ditches not to exceed from 5 to 10 miles in length.

I have examined a good many of these gravels by sampling with pans and found that the values were very uniform, and as a general thing of a very high grade. For example, I examined some property last summer, about 200 acres in area, in the Seventy Mile country which showed values of a little over $6.00 per cubic yard for a depth of 12 feet.



MAIN STREET, DAWSON, ON THE QUEEN'S BIRTHDAY.



THE FOURTH OF JULY IN DAWSON.
A large majority of the Klondikers are Americans.

As to the Nome country and its values I would refer to the reports of the U. S. Geological Survey, which show that the gravels cover a great many square miles of territory and are a very high average value. As to the Kuskoquim country it is only necessary to say this—that mining men have gone into that country at considerable expense and found gravels similar to those in the Forty Mile and Seventy Mile country, but have been unable to do anything on account of the cost of transportation of supplies. In the Rampart or Minook district are large areas of gravel of high grade, but this like all the rest

THE YUKON NEAR DAWSON. IT IS NEARLY A MILE WIDE.
The figure is an Indian chief in his birch-bark canoe.

of the country, is not being developed simply because the cost of transportation makes mining almost prohibitive.

In Siberia with the same kinds of gravel considerable mining is being done, but there, as in the Canadian Yukon, the government is the principal deterrent element. In Alaska the laws are liberal, the regulations as to acquiring mining property very satisfactory, and the United States Government through its Geological Survey and the War Department has done much to develop the resources of that country. But what is wanting above all things is assistance from the Federal Government, either by indirect or direct taxation to improve the means of transportation. The Federal Government has treated

"MUSHING" WOOD WITH WHICH TO THAW GRAVEL.

Alaska very well by having made very good geological surveys and by giving police protection through the Army Department.

I would suggest that the gold miners do not ask anything unreasonable from the Federal Government. I think it may safely be said that miners are always willing to pay their own way. And now I want to suggest a means by which, with the consent of the Federal Government, we can at our own expense pay for wagon roads and trails and so reduce the cost of working as to open up large areas of gravel which do not now pay a profit.

The Federal Government has made provision for irrigation of barren parts of the West out of the sale of public lands. I would suggest that all moneys received from the sale of gravel mines in Alaska be turned over to the War Department to be expended for the building of wagon roads in the different districts of Alaska. At first the income from this source will not be very large, because the Federal Government has not provided land offices and the other machinery necessary to acquire patents for claims. As this source would not bring in revenue enough to satisfy Mr. Cannon of Illinois, I would suggest another source of revenue, and that is that a tax of say one dollar or two dollars per year be levied on each claim located in Alaska, to be expended for the same purpose and in the same way. Such a tax

would do much to keep titles clear, for the simple reason that if the regulations were properly made out no claim owner would be able to hold title without showing a receipt for the payment of his tax. I may say in this connection that in many cases, not only in Alaska but in other parts of the west, we do not know whether claims have been abandoned or not. The payment of this tax would show that the claims had not been abandoned. I know of one outfit in the Seventy Mile country backed by New York and London capital which has over 200 claims of 20 acres each. It will soon apply for patents for its properties, and would pay into the Federal treasury $10,000, which it would gladly see spent on wagon roads to reduce the cost of transportation.

Let it be supposed that not more than 50,000 claims are located in Alaska. This would mean an income of $100,000 per year. Yet in addition to this income, if the Federal Government will give us better facilities for obtaining patents to claims located, a great deal will be added to the Government's income. If Congress would agree that these sums should be appropriated for the building of roads it would very much increase the output of gold and copper and other minerals in Alaska. It would be only fair on the part of the Federal

NO. 16 ELDORADO, SHOWING DUMPS OF GRAVEL THAWED BY STEAM AND HOISTED. THE CLAIM IS BEING WORKED BY A DREDGE.

Government to make advances of money to be expended under the direction of the War Department of from $1,000,000 to $5,000,000 in building roads and trails throughout Alaska, with the understanding that this sum was to be paid back to the government out of the sale of mineral lands or out of a tax, such as I have suggested, of from one dollar to two dollars per claim. Miners, gold miners, have always done more than any other class of people toward developing the re-

OFFICE OF ONE OF THE BIG MINING COMPANIES ON THE BED ROCK LEVEL OF BONANZA BENCHES.

sources of the great West. Were it not for the discovery of gold in California in 1849 there would not have been built a transcontinental railway until many years after 1868, and to-day much of the great country west of the Mississippi river would be practically a wilderness.

There went into the Yukon country in the summer of 1897 at least 5,000 people, and in the summer of 1898 about 40,000. Of these nine-tenths were not fitted for the strenuous life there. Many who went in came back to civiilization without making any attempt to acquire mines or to mine. Of the rest nearly all were men who had mined in the west, or were merchants, or were fitted in other ways for the hard life there, and of these nearly all have done well.

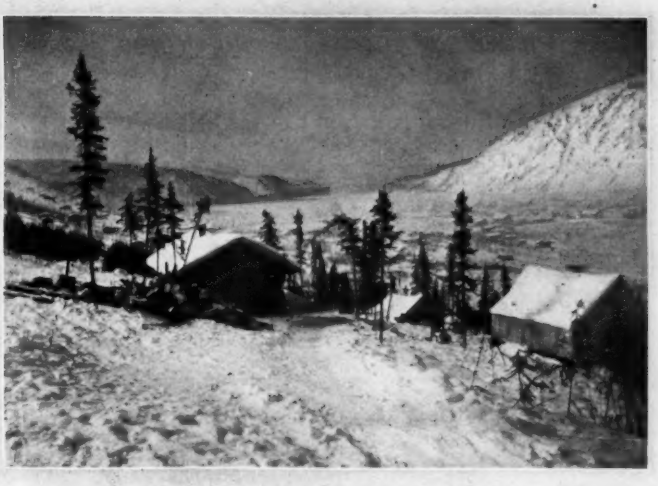
The Canadian government east of the 141st degree placed upon mines most difficult, and in point of fact, ridiculous, regulations which

A SUGGESTION THAT THE WEATHER IS SOMETIMES WARM.

A DOG TEAM IN FRONT STREET, DAWSON, SUMMER OF 1899.

POLING UP STREAM.

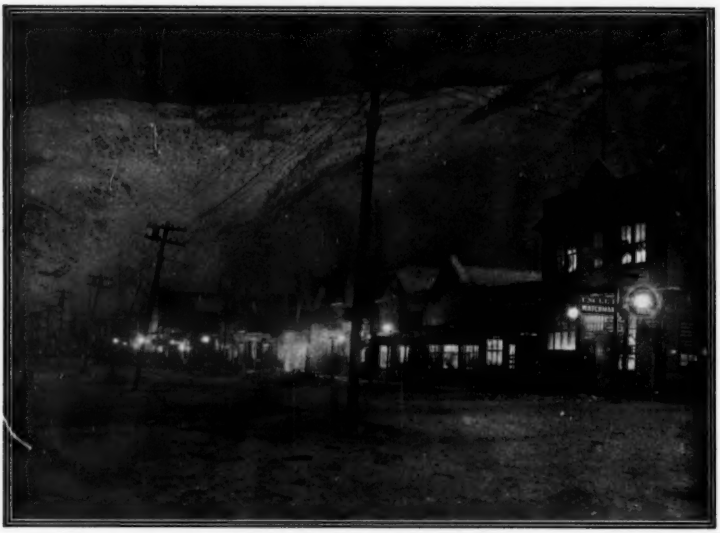
DAWSON FROM "THE SLIDE," 3,000 FEET ABOVE THE CITY.



MOONLIGHT PHOTOGRAPH OF THE YUKON VALLEY NEAR DAWSON.
The picture was made with two hours' exposure, on a winter night.

tended to retard mining or any other industry. However, in spite of all this, on account of the very good values found in the gravel of the Klondike country, a great many of the experienced miners who went there in the early days made money. The result was then, as it was in California in 1849-50, that a very few, and only those who were capable of doing good work in any direction, succeeded. Nine-tenths of those who went to the north were unfitted for the work that it was necessary to do there, and they returned to the States or other parts of the world from whence they came. These men condemned the Klondike, condemned the whole Yukon, and told the rest of the world that there was up there no opportunity for miners. This has done much to give the Yukon a bad name. Yet never a miner who understands gravel has gone into the north who has not said that it is one of the best gravel regions in the world. The best proof of this is that a large proportion of the mine owners of the Klondike who have made fortunes, and most of the miners of experience on the Alaskan side, all the way from the boundary line to Nome, return to that country every year and say that they know of no country in which they would rather live and do business than along the Yukon.

I know what answer will be made to this by the average man in New York and San Francisco. He will say that the climate is bad.



FIRST AVENUE, DAWSON, ON A WINTER NIGHT.
With the moon and the northern light, a winter night even is not very dark. This picture required a two hours' exposure.

I have spent five winters on the Yukon and the past winter in London and New York, and I must say that we have a better climate on the Yukon in winter and in summer than either in New York or London. With us the air is dry. There is no wind. And while the thermometer goes down in winter to as much as 70 degrees below zero (though it is seldom more than 50 degrees below) having no wind and having no dampness in the atmosphere, we wear less clothes and suffer less inconvenience than we would in New York or London in the colder days of winter, or in San Francisco with its fogs and winds.

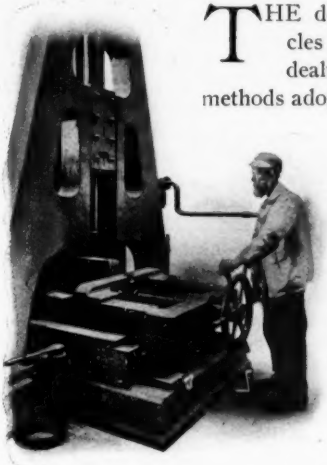
It is proposed to build a railway from Valdes through the copper country to Eagle, on the Yukon, and on to Dawson. At Eagle are the principal United States army headquarters of the Yukon and the officials of that district. With its branches this road would be 500 or 600 miles in length. The grades would be light and the cost of operation comparatively low. The Federal Government should do what it can to encourage any such undertaking, for two reasons. The first is that it would do much to develop a great deal of the country in which there is large mineral wealth not to be reached by water transportation. The second is that it would give the United States control of nearly all the trade of the Canadian Yukon.

THE PROMOTION OF INDUSTRIAL EFFICIENCY AND NATIONAL PROSPERITY.

By John B. C. Kershaw.

III. PAST HINDRANCES, AND A SUGGESTED MODIFICATION OF THE AMERICAN PREMIUM SYSTEM.

In the preceding article of this group, which appeared in our June number, Mr. Kershaw pointed out that "the machine is now ahead of the man" in productive efficiency in the machine shop, and that the great problem of modern economics is to make the worker willing and satisfied to obtain from modern machinery the highest possible yield. He then gave, in brief form, the main outlines of the labour systems of the most successful employers of the Continent, Great Britain, and the United States. A following paper will take up chiefly the question of unionism and its influence on the case.—THE EDITORS.



THE details recorded in the preceding articles have shown that in the three countries dealt with, great diversity characterises the methods adopted for promoting the efficiency of labour, and for obtaining active co-operation of the worker in the particular industry in which he is engaged. Reasons have been given in the introduction to this series of articles, for the belief that the modern conditions of work, and extensive use of machinery in all highly developed industries, demand some change in the methods of rewarding labour. As this opinion may be controverted, two extracts are given to show that the opinion is held by men whose ability to judge in this matter is unquestioned.

On December 27th 1901, Mr. George Livesey—of the South London Gas Company, writing to *The Times* on the "Crisis in British Industry," expressed himself as follows:—

> "The wage-hire system as a transitional step from slavery and serfdom to the ultimate goal of partnership in some form was doubtless the only practicable method. When businesses were small and masters and men worked together there was very much in its favour, and the results were satisfactory; but the entire change of circumstances—the develop-

ment of the factory system, the growth of enormous businesses, and the influence of the trade unions—has divorced employers and *employees* (they must no longer be called masters and men) and produced the present extremely unsatisfactory position. The old ties between the parties are broken, the only connexion in the building trades, for instance, is an hour's time, an hour's pay, an hour's notice—and those who should be friends and in some real sense partners, are in constant antagonism. So far as I could understand Mr. Ashbee I disagreed with him, but there is a sentence which he puts into the mouth of a workman which is perfectly true. He tells us the workman says, 'My employer's business is his business and not mine.' This is the sole and simple reason why the workman takes no interest in it, and this is the position to which the simple wage-hire system has brought British industry. It is the old story; the circumstances have changed, we have adhered to our old methods, and only on the pressure of very urgent necessity shall we think of altering or modifying them.

"We cannot go on as we are. You, Sir, have materially helped to make that impossible; but in what direction must the remedy be sought?"

A paper on "Works Organisation" read by Mr. Tom Westgarth before the North East Coast Institution of Engineers and Ship Builders at West Hartlepool in January 1899, contained the following remarks on payment by results:—

"The writer is satisfied that modern developments and the present-day system of very large works, often controlled by non-resident directors, has been the cause of losing much efficiency through the loss of the personal contact between masters and workmen, and he thinks that everything that is possible should be done by those having the control of large works to foster a friendly spirit between master and workmen. This can of course only be done satisfactorily if the advance is made from both sides, but necessarily the first steps must be taken by the masters. He is also of opinion that more attention might be given to the consideration of profit-sharing, notwithstanding the poor results which have followed efforts in this direction in this district, and he invites the members of this Institution to discuss this subject fully this evening.

"The writer strongly recommends the principle of payment by results, from the managers to foremen and workmen. Managers should be paid partly by a percentage on the profits of the works or of their department; foremen should be paid partly by the bonus upon the quantity of work turned out, providing always that it is satisfactory, and workmen should be paid by piece work, which should, if possible, be supplemented by the comparatively new bonus system, and he sees no reason why apprentices and boys should not also work by piece.

"The writer looks to the gradual, careful, and persistent introduction of the system of payment by results, as being one of the most hopeful means by which we shall be enabled to hold our ground against foreign competitors, and he is of opinion this question is one which will bear very careful consideration and discussion."

These opinions of men in positions of authority reinforce the argument in favor of a general change from the "*laisser faire*" principles which have too long dominated the relations between employers and employed.

Each of the systems of treating the workers described in the preceding articles has some particular merit, but their efficiency as devices for increasing the contentment and output of the worker varies greatly. The agencies for promoting the social and physical comfort of the workers, found in many of the German and in a few of the English and American works, are eminently satisfactory from one point of view, and undoubtedly tend to improve the health of the workers and their families, and to promote good relations between the heads of the firm and their employees. But these agencies do not promote the output of work to the extent that premium or bonus payments promote it. As the battle of industrial competition will in the future be fought largely on the ground of rapid manufacture, it is probable that a modification of the bonus system, on the lines of the American premium system of payment will be generally adopted on the eastern side of the Atlantic. Such a system need not displace the agencies for promoting the social and physical education of the workers already established, but might be worked in conjunction with these. Possibly this will be the case in the more up-to-date works in both countries. My belief that a modified form of the American premium system will displace other profit-sharing systems of payment, is based on the fact that most men, (whether workers or capitalists) prefer a pound in the pocket to a post-dated cheque on a shaky bank, and would rather receive a premium of 50 per cent. on their income paid *weekly*, than a bonus of 5 per cent. or less, paid *annually*. That this is not an unfair statement of the relative rewards offered by the two systems, is proved by comparing the statement as to the average amount of the premium received by the workers in the Westinghouse Company's works at Pittsburg, ranging from 25 to 100 per cent. on the weekly wages, with the Board of Trade report* upon the results of the profit-sharing system in operation in 58 English works, employing 20,000 workers, in the year 1901. In thirteen instances no bonus at all was earned, in twenty-three cases the bonus was under 5 per cent., and in only five of the works did the bonus exceed 11 per cent. The mean bonus for the whole of the works was 5 per cent. Under these circumstances, it is perhaps not surprising that many manufacturers dispute the advantages to be derived from the system of profit-

* The *Labour Gazette*, July, 1902.

sharing usually adopted in Great Britain, and that every year firms fall out of the ranks of those who continue to practise it. The latest withdrawal from the ranks of profit-sharing firms is the Brush Electrical Engineering Co.—of Loughborough—a firm employing between 1,500 and 2,000 men.

From the Board of Trade reports on profit-sharing in the United Kingdom it may be found that up to the end of 1899 over one hundred and seventy-eight firms had tried schemes of profit sharing with their employees, and that of this total, ninety-four had discontinued them, after longer or shorter periods of trial. The reports give details of all these failures, with the assigned causes when these could be ascertained. The chief causes which have operated to produce failure have been—

I. Failure of the business to earn profits.

II. Dissatisfaction of the employees with their share of the profits, when earned.

With regard to the first, this is a condition of affairs that would wreck not only any profit-sharing scheme, but ultimately the business itself, and failure from such a cause cannot be held fatal to the principle. If any firm fails to earn a profit for a continuous series of years, it is evidently necessary for that firm to be placed under more efficient management, or to withdraw from manufacturing operations which do not pay.

The second cause of failure is that which has most hindered progress. The fact that so many firms who have adopted profit sharing, have discontinued it in a few years on account of the dissatisfaction of their employees, has certainly prevented other firms from experimenting on their own account in this direction.

From the figures published in the Board of Trade reports for the period 1896-1899, we find that the mean bonus in that period on the wages paid amounted to 6 per cent. Taking the case of a worker whose average earnings the whole year round are 25 shillings per week, we may calculate that in a year of 300 working days he will have earned £62.10, and that his share under the bonus system will amount to £3.15, or an average of one shilling sixpence per week. This is but a very slight incentive to better work.

Probably when the scheme was inaugurated with great expectations on both sides as to the advantages which would accrue, the employee had not realised that the final outcome would be equivalent to such a small addition to his weekly earnings, and his disappointment is proportionately great. On the other side there has been the

employer, conscious that he was voluntarily surrendering a portion of his profits to the workers, and hoping that this might lead to better work and to a greater devotion to his interests. During the first year these results were to some extent attained. But when the second year was entered upon, and the disillusioned employee fell back to his former level of inefficiency and indifference; the employer saw little use in continuance of a scheme which diminished his profits, without increasing the efficiency of his servants. Such, without doubt, has been the history of many of the failures. A study of recent figures would seem to indicate that more failures from this cause may occur. In 1901, the bonus payments of thirty-six, or more than one-half of the total number of firms making returns, were less than 5 per cent. on the wages.

The difficulty might be overcome by making the profit-sharing scheme more attractive to the average employee. This could be effected by increasing the bonus fund to an amount equal to between 20 per cent. and 40 per cent. of the annual wages, and in paying, say one-half or two-thirds of this, weekly, instead of annually. The amount of this weekly payment would be based on the efficiency of the employee's work, and would be calculated in engineering works by the Halsey system. The remaining one-half, or one-third, would be invested in the name of the individual worker in the Company's ordinary shares, and would carry the usual rate of interest. When a worker left the employ of the firm, he would receive a cash payment equivalent to the market value of his shares, plus the accumulated interest. Employers will of course argue that such an increase of the bonus fund would swallow up the whole of the present profits of their businesses. That is possibly quite true. We are dealing, however, not with *present profits*, but with *future profits*, and such an increase of the bonus fund would undoubtedly pay, in many of our manufacturing industries. It has been shown that the mean bonus received by the workers under the schemes of profit sharing at present in force is equivalent to an addition of about one and sixpence per week to the wages of the average working man. Supposing that the addition were 10 shillings per week, in place of one shilling and sixpence, and that a working man whose ordinary wages were say 25 shillings per week, had a chance of increasing this to an average of 35 shillings by the introduction of the proposed modification of the usual system of profit sharing. Would not this possible increase prove a very effective incentive to better work, and to greater devotion to his employer's interests?

The experience gained in the course of the erection of the buildings

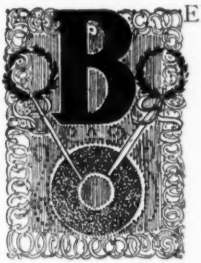
for the new factory of the British Westinghouse Company at Trafford Park, Manchester, in 1901, shows that most astonishing results can be obtained from British workers, when facilities are offered for rapid output, and when this is promoted by wages rather in excess of the trades-union rates. The number of bricks laid per man during the building of this factory at Trafford Park was *three to four times greater* than is customary for the same class of work in the United Kingdom, and the figures published in the *Times* last year have been disputed by trades-union officials as incredible. In view of this experience, it is not unreasonable to assume that the general adoption of the proposed modification of the bonus system would have a remarkable effect in promoting the output and prosperity of many manufacturing industries, and in enabling British manufacturers to meet more effectually the new conditions of international competition.

In the final article of this series, the writer will dicuss the future of bonus and premium systems of payment and the trades unions' hostility to their extension in the United Kingdom and in America.

THE COMMERCIAL MANAGEMENT OF FACTORIES.

By Ian Andrews.

In an article under this same general title which appeared in our issue for February last, Mr. Andrews discussed the relations which the office manager, or managing director, should bear to the organisation of the works and its commercial policy. The supplementary portion of this review, now presented, considers his relations and functions in the direction of cost reduction.—THE EDITORS.



EFORE erecting new works, the adaptability of the proposed factory to its special purpose should be a first consideration, and where practicable the locality chosen should be convenient to the principal markets and a centre of labour, and in proximity to the source from which raw material is chiefly obtained. Such a combination of advantages, however, is perhaps seldom attainable, and even when possible, may be too costly.

Ground rents and the cost of land in populous commercial centres are usually very high, and manufacturers are therefore at times compelled to erect works at some distance from industrial centres, in which case they frequently attract sufficient labour by providing cottage accommodation for their employees at fair rents to yield a return on the investment.

In an established factory the manager may have many difficulties to contend with if the works have not been carefully planned in view of all circumstances, and the most he can do in such a case is to minimise the consequent disadvantages by judicious internal economies and by structural modifications.

Unless the factory is arranged in such a way that the different stages of manufacture are carried out in progressive order, there will be a considerable amount of unremunerative labour. The ideal factory is that in which there is no unnecessary handling of raw material and in which everything when received at the works is stored so as to be readily available for the various departments, and thereafter so handled throughout the whole course of manufacture that it will not

go through any backward movement, but from stage to stage, until ready for the market.

When other considerations are favourable, it is an advantage to construct factories as far as possible on one floor, so as to minimise labour; for it is obvious that otherwise the cost of handling will be very considerable, everything that is taken up stairs having to be brought down again.

The shops should be provided with all the daylight available—which in the case of those on one floor can be readily attained—and they should be so arranged, that the respective foremen can see all that is going on, as, when they have each to supervise a number of small shops, much time is lost and the supervision is less effective than when the foremen are so to speak, on the spot.

In stores requiring a number of assistants, to give out material to the workers, it is desirable, as far as possible, to deliver stores only between certain hours, for, when men are irregularly coming and going, their own time and that of the store keepers is unnecessarily wasted, the latter being also called away from other work, such as stacking and counting goods, or writing out their accounts, and the accuracy of their work consequently suffers.

These remarks are directed against unnecessary labour, but there is also the prevention of waste to consider. Preventable waste, in the aggregate, accounts for millions of money, and in a single factory may amount to hundreds or thousands. It therefore behoves all concerned to detect and avoid it—or rather to minimise it, for in large factories this may be the most that can be attained, as very much depends upon the individual efforts of employees. If, however, a good feeling exists between master and workmen, and both appreciate the fact that their interests are bound together, large economies will result. This principle is the basis of profit-sharing schemes, and its application under favourable conditions leads to reduced cost of production, by the exercise of economy, while it also benefits the employees pecuniarily.

I cannot here enter into so large a subject as that of employees' profit sharing, or into the premium system for special industry, but it will be obvious that, if the relationship between employers and workers is satisfactory, waste will be greatly minimised as a result of voluntary effort. Frequently waste arises through thoughtlessness. This is specially noticeable in the consumption of gas, which is often in excess of requirements, either because used extravagantly, or without regard to the best burning conditions, or because of original faults

of installation in regard to the position of the lights, which first and last objections may apply to the use of electric light. In this connection regular readings of meters should be taken and compared with previous records in relation to the output, number of employees, or other convenient basis.

In these days of trades unionism, the employer cannot afford to ignore its existence, and with fair-minded men, he will gain their confidence, by recognising their Union; within reasonable limits, for, if they are satisfied as to his *bona fides* there is not much to fear regarding its undue influence.

It is an employer's duty to look after the comfort and improvement of his workers, as far as possible, and happily we have notable examples of what may be done in this direction, by not a few large employers of labour. It is of course imperative that the risk of accident be minimised by all possible precautions, for the protection of life and limb; but having done all this, it will be advisable to insure against the monetary risk of accident.

I attach great importance to the co-operation of employees, in regard to the methods of production. Many intelligent workmen could suggest improvements, but for lack of encouragement they feel it no business of theirs to do so. Such a state of things operates against all interests, and the sooner it is altered the better will it be for all concerned; for inventive genius should at all times be encouraged and suitably recognised. If it is not, the employer may not only lose the benefit of his workmen's suggestions, but may find that their ideas have been carried to trade competitors, with the result that valuable inventions are developed and monopolised by others, for a number of years, to the former employer's permanent loss.

It is obviously an advantage to retain workmen in as regular employment as possible; otherwise the services of good men may be permanently lost to the firm—although as a matter of course, these should be the last to be discharged when there is a business lull. Old servants should always be encouraged, having generally a greater interest in their employer's business than new hands; at the same time the infusion of new blood into the various departments is desirable, as one cannot afford in these days of keen competition and progressive industrial methods to be too conservative of old ideas, which may be capable of improvement.

Inefficient workmen, like poor tools, are dear at any price; and it is therefore essential that only capable men be employed, and that they receive good wages. Regularity and punctuality should also be in-

sisted on, for it is a source of loss to run a factory when a number of employees are absent or systematically late in arriving at work. As a fixed amount of running expenses is incurred during a working day—for supervision, power, artificial light, heat, and other items—it follows that the vacant bench is unremunerative.

Whether the employees should be paid by piece or day wage—either with or without a premium for industry—will depend largely on circumstances and the nature of the work produced. In some trades piece work may be a source of danger, as in the case of work which has to be mathematically adjusted, where such a system of payment might lead to careless finish.* Where, however, the nature of the work will permit, and where there is careful supervision, there can be no doubt that employer and employee benefit under the piece-work system, so long as earnings are equitably adjusted. Employers should however see that labour really benefits by the system, for workmen cannot be expected to give their best energies without some distinct monetary gain. In other words, the advantages of piece work or any premium system must be fairly divided.

In the purchase of raw materials, it will be found advantageous to make out specifications of requirements, at regular intervals, when the several store keepers should furnish stock sheets, to enable the manager to estimate his requirements. Quotations will then be obtained from leading houses, and orders placed accordingly, delivery being taken by instalments during the period which will elapse before the date of next ordering. It is a mistake to be frequently buying goods just as tsocks require replenishing, for there is then a serious risk of running short. When however, the replenishing of stock is considered at regular intervals, the matter receives more careful attention and the requirements of each period can be compared with those of the previous or corresponding one.

Generally, better terms can be obtained for large purchases, and in such cases it is desirable to place orders for the several branches when buying for the parent establishment, for, though orders may be placed at one time, delivery, as a rule, need only be taken to suit the convenience of each branch. Frequently it may be desirable, to make contracts for a lengthened period, especially at times when market prices are low.

* This is a natural apprehension, but is not borne out by facts, as will be apparent on comparison with Mr. Colwell's article in our May number. The fact proves to be that the ambitious workman under the piece-rate or premium plan realises that he has more to lose than his employers from defective work, and that such work will certainly be found and rejected by the inspector.

While the cost of production should be minimised by all legitimate means consistent with the maintenance of quality, it is no less important and necessary that a complete system of cost keeping be adopted. Many firms are satisfied with more or less approximate costs, because, at the end of the year, they find that there is a fair margin of profit over all; but without accurate costs they cannot tell whether on some branches they are not losing money.

In order to facilitate the costing of all manufactured goods, there should be a book of "Prices Current" showing the latest cost of all purchases; from this, together with the works' job books, the cost of manufacture is readily ascertained. It is a serious loss of time to refer to invoices for the cost of materials, as the work has frequently to be repeated when revising costs; but when the invoice clerk who checks all inward invoices enters up the latest prices in alphabetical order in "Prices Current," the information is readily available, and greatly facilitates the work of the cost clerk.

Wages books should be carefully analysed, in order to obtain accurate costs; and if weekly wages totals are compared in relation to output, it will facilitate the detection of error or mismanagement.

The question of working expenses has a most important bearing on the profits, for as the expenses of conducting a business are high or low, so will the dividends be inversely affected. For a minimum output, certain charges, such as rent, rates, taxes, insurance, management, supervision, salaries of clerks, etc., are necessarily incurred each year, and will vary but little, with any output, between that minimum and a certain maximum. For example, say that the annual sales amount to £250,000 and the working expenses to £30,000; it is conceivable that, if such sales were increased to, say, £300,000, the expenses might not greatly exceed the above figure, or at all events would not increase in proportion, simply because the same establishment is equal to the increased trade; or, in other words, the resources of the factory are not in the first instance fully employed. If the output be only three-fourths of the factory's capacity, it is clear that these three-fourths are bearing, say, one-fourth more of the establishment expenses than might otherwise be chargeable, and that being so, it is equally clear that, if the output be increased to the full capacity, the profits will increase, even though the additional business be less remunerative, provided that the selling price is not bare cost, but carries with it a margin for working expenses. But before advocating any policy that might suggest itself on arriving at this conclusion, it is first assumed that the output has been and under ordinary con-

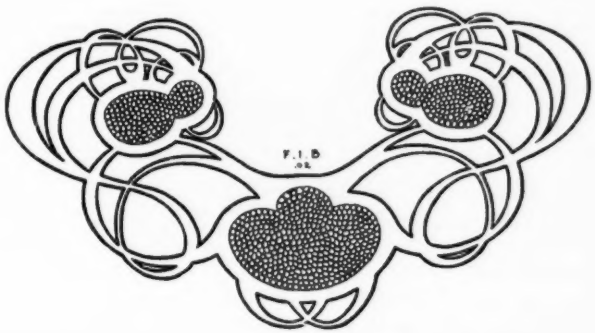
ditions is likely to remain, stationary, and that the manufacturer has no specialty to take the market. A demand has to be created, and cheapness primarily is, in these days of competition, the great means to this end. Let us look at the case of gas companies, who, to induce an increased consumption, sell gas for motive power and other purposes at a lower price than they charge for lighting. They can afford to do so, having already the plant and facilities for their ordinary make, and the working expenses connected with the manufacture and distribution of the increased quantity are comparatively small. Although the case of a gas company and that of a manufacturer are perhaps, not alike—the company having a monopoly which the other has not—the principle involved is the same, and it may be recognised in the shape of contracts. Contracts on a large scale are sometimes taken at prices which would not pay on smaller business, but which, as bringing additional grist to the mill, keep the factory fully employed and earn a profit, however small. The fact that the manufacturer has generally no monopoly reminds us that he runs the risk, when selling cheaply to large buyers, of having to reduce his prices to smaller consumers. He has, however, in that event the advantage of a factory fully employed, enabling him to compete successfully with others, should they compel him to reduce his prices generally. Even if he does not accept contract work at low prices, but leaves it to other manufacturers, he will still run the risk of competition without having the advantage referred to. In other words, competition on the part of a few affects the many, by lowering prices, and it is therefore advisable to be early in the field, and to take the advantages offered by a good going concern to minimise the rate of working expenses. The percentage of working expenses may also be minmised by an established factory, which is only partially employed, branching out into another line of business more or less allied to its own, for which it may be adapted. Having already a fully equipped establishment for its staple manufactures, it may be able to produce other goods at less cost than a factory more narrowly confined in its operations.

While the foregoing remarks indicate the possibility of increasing output without a proportionate increase of working expenses, it is often possible to reduce the actual working expenses without affecting the efficiency of production. Too often working expenses are allowed to eat into the profits of a business without a due appreciation of the fact. It is therefore very desirable to scrutinise all expenditure under this head, for which purpose an analysis of the periodical accounts

should be made. Each item of expense can be worked out as a percentage on the sales, or other convenient basis, and compared with previous years figures. If the total of sales is taken as the basis, allowance may have to be made for fluctuations in selling price, and for this reason some fixed unit is to be preferred for comparison.

In conclusion, I would recommend that in the counting house, there should be a regular monthly audit at least as comprehensive as the official audit, which is generally conducted after the balance is struck. The management should not be satisfied with an audit which takes place only at long intervals. The real object of an audit should be to check errors immediately, not merely to detect them several months after they have been made, when the delay may have serious consequences. Part of the duties of the audit department will be to submit periodical returns and analyses, so that the progress of the business may be observed and errors of administration remedied.

The foregoing remarks will suggest to the manager numerous details having a bearing on the subject, which he can critically investigate for himself, with, at least, one good result—that, if he is unable to economise—(and he will surely find *some* room for economy) he will have the satisfaction of knowing that nothing has been overlooked in the administration of his business. Finally, he will bear in mind the necessity of providing, as far as possible, against the exigencies of strikes, fluctuating markets, and any risk likely to bring his works to a standstill, and he will seek to cultivate that kindly interest in his employees which goes far to secure faithful and profitable service.



THE USE OF IRON PIPE IN STRUCTURAL WORK.

By Egbert P. Watson.

The list of possibilities opened by Mr. Watson's suggestions would extend to a long catalogue. His article will serve the purpose of giving an idea which the managers of many industrial establishments can no doubt develop advantageously to suit their particular needs. —THE EDITORS.

THE facility with which commercial iron pipe bought in open market lends itself to building purposes, in so far as stress, strain, and flexibility in design are concerned, is remarkable, and it should be more generally used than it is for various purposes. A marked economic feature in the use of iron pipe is found in the great variety of connections, or fittings as they are called in the trade; these permit of almost endless combinations and adaptations to special situations, and, in comparison with wood, cost very much less, when the waste of material and the item of labor in wasting it are considered. Add to the foregoing citations the ease with which the material can be fastened together, the rigidity and lightness of the whole structure in comparison with wood, and we have a strong case for the employment of iron pipe, or steel if preferred for structural work, wherever it is possible to substitute it. In tropical countries, where insects destroy wooden buildings quickly, iron pipe lends itself as a material to check their ravages most admirably, and as it can be built up in any form in a shop and then taken down and re-erected by comparatively unskilled labor where it is to be used, it would seem worthy of attention as an enterprise.

I do not claim to be the discoverer of iron pipe in structural work, for it is now used in many situations for which it is obviously suited—railings, for example; but this appears to be the only case where it is generally employed, when, as a matter of fact, its range is very wide—so much so that I have ventured to call attention to it.

Figure 1 is a church steeple constructed wholly of iron or steel pipe so far as the frame is concerned. The connections can all be purchased in open market, and the whole structure is fire-proof if slates be used in lieu of shingles or weather boards for the exterior; the only wood employed in it is in the ceiling and furring strips to which it is attached; these last are covered by the slates and not exposed externally.

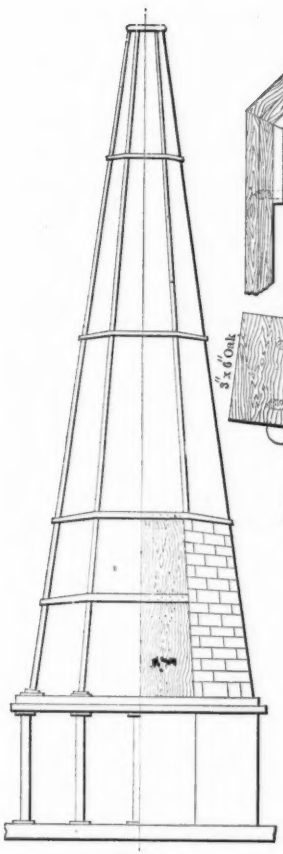


Fig. 1

A STEEPLE MADE OF ORDINARY PIPE AND FITTINGS.

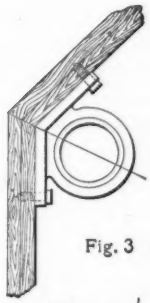


Fig. 3

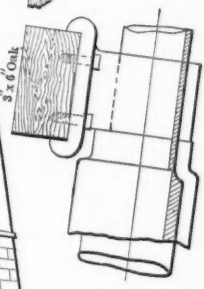


Fig. 2

Now if we consider the rapidity and ease with which such a steeple can be erected without any scaffolding, its decreased cost in all directions—labor, material, time, and other items which enter into the expense accounts—I think I have made out a case for this particular example. I have stated above that no scaffolding is needed in the erection of this steeple, and this will be admitted when it is seen that a few planks placed across the horizontal braces inside will give all the support needed to handle the pipe sections; these last are light, except in the first course, and can easily be assembled by two men. The security, both moral and physical, given by the fact that they are in no danger enables the workmen to give all their attention to the job.

It is possibly necessary to say here to some who are not familiar with commercial iron pipe and its fittings, that this material can be had in all needed weights and sections for the work to be done, that is, loads per square foot of floor area, or strains per square inch. The fittings are not confined to those familiar in household plumbing, but may be had amply strong for any work, such as hydraulic fittings, where the strains are severe and abrupt. The sizes, too, are convenient for application to a wide range of subjects; from ⅛ inch in the bore (all pipe

sizes are reckoned by the diameter of the hole through them, not usually by the outer diameter) to 20 inches bore, and from ¼ inch thickness of wall to ¾ inch, in extra and double-thick pipe, giving factors of safety of any ratio required.

It is proper to say that no attempt has been made to furnish a working drawing in the illustration of the steeple, for obvious reasons, but any architect or engineer can readily make one from the suggestions in this article. The design is on an approximate scale 1/20 inch to 12 inches but the limited space available for the example makes some of the members appear very frail.

The pipe lengths are 20 feet long in each section, and, respectively, 5-inch, double extra strong, (about ⅞ of one inch thick in the walls) 4½ inches, extra strong (.378 of one inch thick) 4-inch extra strong, and 3-inch standard pipe for the top course, all outside diameters and steel pipe. The cost of this at present list and discounts would be $450 more or less, by reason of the varying discount for less than one carload. The weight of the whole lot would be in round numbers a little over 5 tons for pipe and connections. This steel frame would rest upon the campanile and be bolted to the roof timbers in the usual way. The exterior sheathing and covering would be attached to the timber braces as shown, by brackets of cast iron slipped over each course of pipe as it is erected. These brackets rest upon the pipe-couplings and require no attachment to the pipes, for they cannot move up or down; the pipes are, therefore, free to expand or contract, as the weather compels. No holes are to be drilled in them.

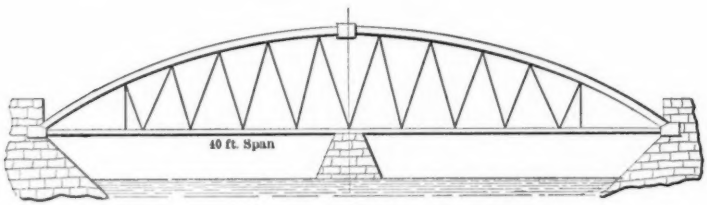


FIG. 4. BRIDGE SPAN BUILT OF STEEL PIPE.

Now compare this estimate with a timber frame and it will be seen that the steel construction is very much less. I consulted three builders of long experience in this class of work and they did not vary materially in their statements as to the cost of a wooden structure; this was $1,000 at the lowest estimate. While wood is of course much cheaper than steel it must be borne in mind that the labor account in the former is serious, both skilled and unskilled, while in the case of the pipe frame

FIG. 5. DESIGN FOR IRON RAILING.

the material comes from the mill ready to erect, and the setting up is a small matter. I have said nothing about the exterior sheathing, slating, and scaffolding, but the latter is an expensive item in the wooden frame; the cost of the outside work would be the same in one case as the other, no matter whether steel or wood be employed.

Pipe construction is especially useful and available for highway bridges in sparsely settled sections where the township funds are small for such purposes. A single arch formed of two pipes of the proper size for the span and greatest probable load, or one pipe if the span is less than 20 feet, can be easily sprung over a creek or ravine without the services of engineers and bridge builders, and at a nominal cost. The anchorages are quite within the capacity of men of ordinary intelligence, and all the fittings can be bought in open market, leaving only their assemblage and the flooring to be dealt with. The sketch shows such a bridge for a span of 40 feet and a maximum load of 10 tons, which is much greater than the average country traffic requires. The margin of safety is nearly four times the working load. It should be readily erected by a village blacksmith, he supplying the suspender straps or radius bars for the floor also. The cost of this bridge exclusive of labor would be inside of $200 for material only.

If necessary for navigation the central pier can be omitted. 40 feet span is a pretty good length for a township bridge, and would be longer than is needed in most situations, but the use of pipe of the proper dimensions is possible and economical; the shorter the span the more readily it can be erected by unskilled labor.

The fence panel shown in Figure 5 is a suggestion for cemetery or other work where it is appropriate; it is all pipe and pipe-fittings with the exception of the casting at the top, which may be varied to suit the surroundings and nature of the structure it confines.

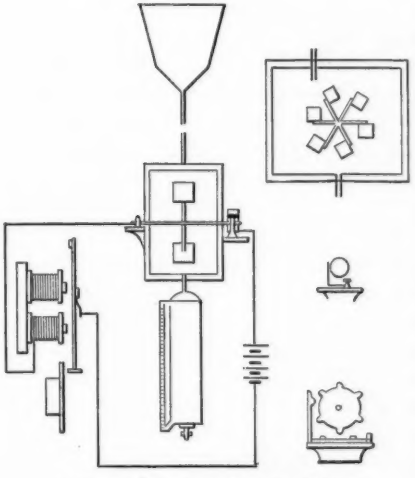
APPLICATIONS OF ELECTRICITY TO AGRICULTURE.

By Emile Guarini.

Reference was made in these pages not many months ago to the possibility that even agriculture might be brought under the direction and control of the engineer—in its routine, that is, as distinguished from special interventions. In the latter direction the irrigation engineer has been a beneficent providence to the agriculturist from time immemorial. M. Guarini makes an interesting showing of the advance which the electrical engineer is now making in the reduction of the ordinary operations of farming to a basis of scientific economy.—THE EDITORS.

HE century just closed well merits the name given it—"the century of electricity." It was the nineteenth century which assisted in the discovery of the laws governing this elementary force and which saw the birth of the many marvellous inventions making electricity the daily servant, in every workshop and every industry, of perfection and economy in production. Agriculture alone, bound to its superannuated methods, seems to be an exception offering no welcome to this new auxiliary. I do not mean to say that no attempt whatever has been made in this direction, but that it is still extremely rarely that even large agricultural undertakings make any important use of electricity, while almost every workshop, however insignificant, has its electric installation, large or small.

This abstention on the part of agriculture is the more regrettable because the advantages which it thus fails to grasp are really great. It has been clearly shown, for example, that electricity, far from injuring vegetation as had been alleged, actually aids its development and under certain conditions exerts upon it an influence analogous to that of electro-therapy upon the human system. Beyond this, there are many applications of electricity to be made on the farm. It will be enough for the present to cite, as the most important: 1.—The lighting of the fields for night work, and the lighting of the farm house and its outbuildings. 2.—Telegraphic and telephonic communication between farms, minimising the disastrous effects of isolation in sparsely settled districts like certain parts of South America, the Congo, etc. 3.—The supply of a motive power highly



LANCETTA'S ELECTRIC RAIN GAUGE.

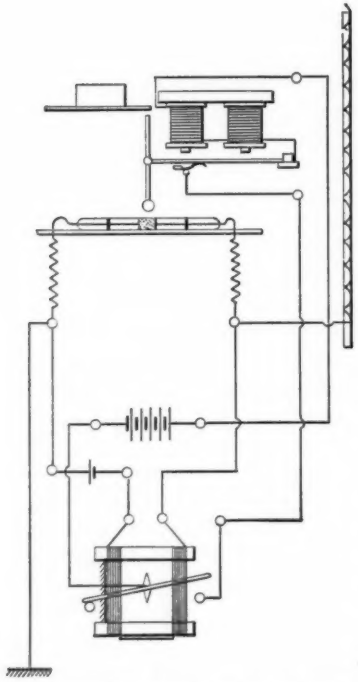
adapted to agriculture—that is to say, economical, divisible into small units, easy of transmission, and demanding little oversight.

Leaving aside with some regret, as outside the proper province of this Magazine, the interesting subject of the influence of electric currents and electric light upon the growth and quality of crops, and turning our attention to the more mechanical applications, we find so many that we must select again even from this list. Thus, for example, electricity may be applied to the aging of wine. But it has more important services than that to render to agriculture, as (among others) through the agency of two pieces of apparatus devised by the well-known Italian meteorologist, Lancetta—the "pluviometer" or rain gauge, and the electrograph. The former is designed to give the farmer most useful data of rainfall; the second, to indicate the progress of storms. The importance of this information to paragrandine stations is manifest. Exact observations of the local rainfall also, as everyone knows, are of the utmost value to agriculture, but the ordinary rain gauge is defective in that it does not give sufficiently precise indications of the ***character*** of the downfall. This point, however, is of prime import, because while fine and frequent rains keep the soil fresh and moist, a violent downpour carries away in the rush of its waters not only the seeds and growing plants. but even the fertile top soil; its effects are therefore almost wholly destructive. It is true that instruments existed which gave the needful information, but they were far too expensive. To overcome this drawback Professor Lancetta devised his registering rain gauge which is inexpensive, simple in construction, and entirely automatic in its acton.

This electric rain gauge is composed of four parts: 1.—The collecting receiver, which may be placed, for example, on the roof. 2.—The measuring apparatus, placed near to or far from the receiver as may be convenient—perhaps in the room with the rest of the appa-

ratus. 3.—The graduated receiver. 4.—The registering device, placed as far as convenience may require from the other parts. A tube carries the water collected in the receiver to the measuring apparatus, consisting of a little water wheel (a sort of bucket wheel) on an axle one end of which is in frictional contact with a conducting wire forming part of the circuit, while the other end carries a toothed wheel which, as it turns, makes and breaks circuit with a contact connected with a battery and an electro-magnet whose armature carries a pencil. This pencil marks on a dial carrying the hours and turned by clockwork one revolution in twenty-four hours. The graduated receiver is directly under the metering device and communicates with it by a tube; a small glass graduate on the side of this receiver permits the height of the collected rain water to be read in figures reduced to millimetres of rainfall.

The wheel of the measuring apparatus consists of several small buckets so held by a spring that the wheel does not turn until the one of these buckets immediately under the funnel of the collector is entirely filled. As soon as this occurs, the spring yields, the wheel turns, one of the teeth of the circuit breaker carried on the end of the axle makes contact with a strip attached to the battery circuit, which is thus closed; the armature of the electro-magnet is attracted and the pencil marks on the dial. Each point thus marked corresponds to one millimetre of rainfall. The device therefore indicates the total fall and the time of its duration. It shows further the exact time of the commencement and cessation of the rain, the interruptions during the twenty-four hours, the duration of the maximum downfall and the rate at any time, since the faster the fall, the closer together will be



THE LANCETTA ELECTRIC STORM DETECTOR.

the points on the dial. These records permit the construction of charts invaluable to agriculture.

The second of Professor Lancetta's inventions relates to the detection of electric discharges in the atmosphere. His electrograph (Figure 7) consists of a coherer—connected on one side to the earth and on the other to an antenna—in circuit with a battery and the coil of a galvanometer. The galvanometer needle, as it turns, oscillates a small strip of platinum foil attached to it which closes the circuit of a battery and sounder. The armature of the sounder carries a pen or a pencil on one side and a hammer on the other. The registering device is completed by a dial marked with the hours, which is moved before the pencil by clockwork, making one complete revolution in twenty-four hours. When the coherer is affected by a lightning discharge, the galvanometer closes the sounder circuit. As the sounder armature is attracted, the pencil it carries marks upon the dial at every downward movement; at each interruption, as it is released, in its upward movement it strikes and de-coheres the tube of filings. By adding a second sounder, attention might be called immediately to the recording of any signal and the observer thus be put in position to follow from the outset the progress of a storm.

Strokes of the bell at comparatively long intervals would signify: "Storm in sight—probability of its coming." Strokes becoming increasingly more frequent would indicate: "The storm increases in intensity, or approaches; the probability of its coming increases." The progressive retardation of the signals after an acceleration would mean: "The storm diminishes, or grows more distant; the probability is that it will not reach the place of observation."

Coming now to the larger applications, the first to be considered is electric lighting. The benefits which it can confer in this field are most striking when one contemplates the possibility of replacing the dim and dangerous stable lantern or the smoky and odoriferous oil lamp by the brilliant and hygienic incandescent light which, everywhere adaptable, is controlled by simply touching a button and brings comfort and convenience with it. Elsewhere, again, arc lights may illuminate the yards, however large, and even light the fields for night work with a brilliancy and convenience unapproachable by any other method. The same generating plant which supplies power for operating the ploughs by day can—perhaps with the necessary assistance of accumulators—furnish the lighting by night.

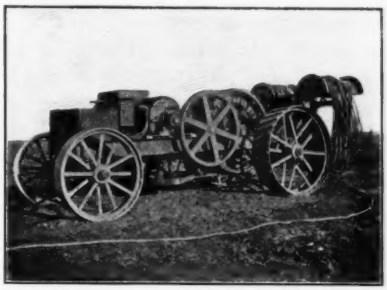
But if, in spite of its manifest advantages, electric lighting has had very limited introduction on the farm, telephony and telegraphy, so far

as my knowledge goes, are absolutely unused there. It may be because the advantages to be gained do not seem sufficiently important, or because there has not yet been offered apparatus simple enough and easy enough to manage to be placed in the hands of farmers, or because the installations are too costly, or simply because the people of the country are indisposed to progress. I am inclined rather to this last hypothesis, for the advantages they would derive from the use of methods of electric communication are strikingly apparent. Connection with market towns, for example, to cite no other, would give constant and prompt advices upon the course of prices and enable advantage to be taken of opportunities of sale or purchase. The proposition evidently applies only to large isolated farms or to detached hamlets where there is no telegraph or telephone office and sometimes not even a post office. The remaining question is whether the advantages to be gained would warrant the expense of the installation. The answer would naturally be the negative if an entire network of wires must be installed. This is the situation in which wireless telegraphy comes into play. For that no lines are needed, nothing but certain apparatus which may be large or small, costly or cheap, easy or difficult to manipulate, depending on the distance to be overcome. And telephony without wires—will not that supersede telegraphy? I am disposed to think so. Telephony requires no educated skill; it requires ability only to hear and to talk. There remains one difficulty—unfortunately a capital one—that wireless telephony is as yet making only its first steps, and those not very well assured. Preece and Gavey in England have, however, already succeeded in communicating at a distance of 7 kilometres, Collins in America at a mile, Maiche in France at 4 kilometres. A little more patience, and the solution will be found.

Of all applications of electricity to agriculture, by far the most important is unquestionably the adaptation of electric motors to the work of ploughing. Electric ploughs are operated under two systems—the single motor with anchor car, and the two-motor. For light homogeneous soils requiring only shallow working, the single-motor system is preferable on account of the moderate cost of installation and the ease of manipulation. For deep ploughing, however, with furrows of 36 centimetres (14 inches) or more in depth, and in rough ground, preference falls to the two-motor system.

The apparatus in the single-motor system is in three parts—the travelling electric motor, shown on the opposite page, which is placed on one side of the field, the anchor car, placed on the opposite side, and

the rope transmitting the power. In the two-motor system the anchor car is replaced by a second motor; the motors operate alternately in moving the plough back and forth across the field. 60 horse power are requisite as a maximum for turning a 36-centimetre furrow in heavy soil. The travelling motors must of course be drawn by horse from the farm to the first point of contact with the electric cables.

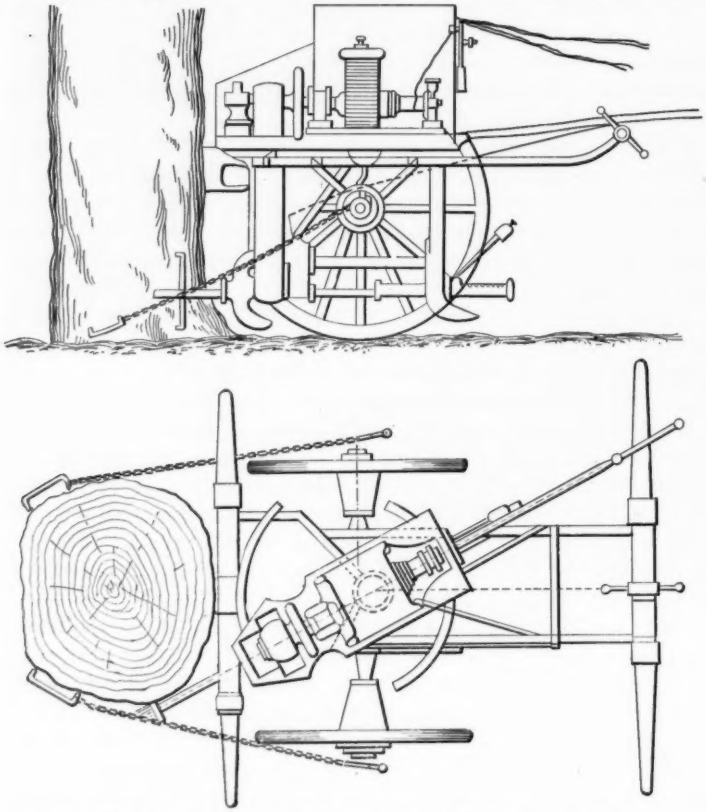


TRAVELLING ELECTRIC MOTOR, ELECTRIC PLOUGHING SYSTEM.

In an installation recently put in by Magnin & Bureau the cost of ploughing 2,100 square metres—say a length of furrow of 2,400 metres—with four men, was 12 kilowatt hours. The area ploughed in a winter day was 1.6 hectares (4 acres); the depth of the furrows was 23 centimetres, the breadth 73 centimetres (9 inches by 29 inches); the resistance of the soil was 55 kilogrammes per square decimetre (1,130 pounds per square foot); the efficiency was 45.4 per cent. on an expenditure of about 30 horse power. In experiments by Félix Prat and Enguibaud, the efficiency was 43 per cent. and the cost 110 francs per hectare ($9.20 or £1 18 4 per acre); the installation cost 30,000 francs and would work about 1/3 of a hectare (about ¾ acre) a day with four men. It should be said at this point that the German agriculturist Brutschwe has calculated that 4 hectares could be ploughed to a depth of 35 centimetres in one day on 90 kilowatt hours. Taking the kilowatt at 0.29 francs (5.5 cents or 2.75 d) and counting in all expenses for wages, upkeep, interest, sinking fund, etc., the total cost of electric ploughing would be 25.89 francs per hectare ($2.09 or £0 8 8 per acre). A French authority on agriculture, M. Ringelmann, disputes these figures and asserts that the kilowatt hour should be taken at 0.36 franc, bringing the cost up to 38.62 francs per hectare ($2.32 or £0 9 8 per acre). Further, if the area ploughed be increased to 6 hectares a day instead of 4, the cost will fall, according to Ringelmann, to 25.75 francs per hectare. Agriculturists are in accord in putting the efficiency of the steam plough at only 25 per cent., and that of the electric plough at 50 per cent.

Other uses of electromotors in agriculture are for running various machines, such as those for cutting straw, hay, carrots, or for break-

ing up oil cake, threshing wheat, etc. Another curious machine meriting notice (see below) is one invented and built by Ganz for the felling of trees. It is said to be much used in the forests of Galicia The machine carries an electric motor on a platform supported on a pair of wheels. By means of a belt, the pulley of the motor drives a routing tool supported on the lower part of the apparatus, levers



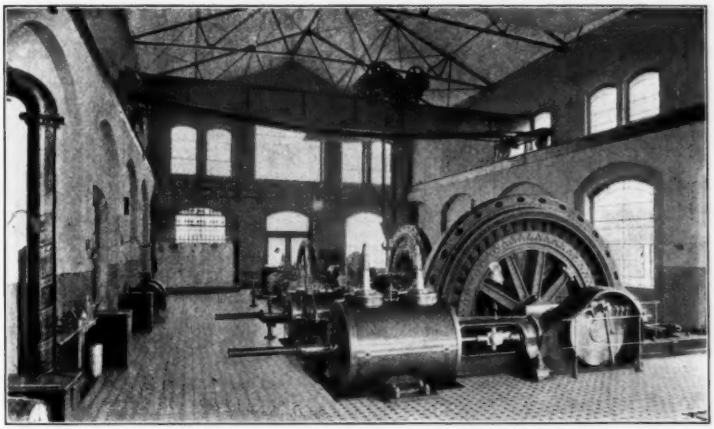
ELECTRIC APPLIANCE FOR FELLING TIMBER. ELEVATION AND PLAN.

serving to swing both motor and boring tool. In use, the machine is brought up against the tree, the motor is started, and the router is swept radially across the tree trunk as it cuts its way in. In this way the tree is very quickly felled.

In Algeria also are found some ingenious applications of elec·

tricity to agricultural work. It is there in practical use for driving a sort of collector which picks up the grapes from the ground and carries them to the press, for the traction of the ploughs used in cultivating the vineyards, and for operating cars, elevators, pumps, etc.

Notwithstanding the manifest advantages of these various appliances, electrically equipped farms are so far few. This is to be explained partly by the conservatism with which the farming class generally hold to the institutions of their fathers, and partly by the



ELECTRIC CENTRAL STATION, CROTTORF AGRICULTURAL INSTALLATION.

fact that to be really practical and economical, an agricultural electric installation requires the association of a number of farmers. And it may be remarked, by the way, that in farming districts the spirit of association is hardly more than embryonic. Indeed, for a farm to have an electric installation at its sole disposition, it is practically requisite for it to combine with the farming some collateral industry, such as a creamery or a brewery—a thing necessitating considerable capital. Under these conditions, however, the turbines or engines which supply power for the auxiliary industry may with advantage operate the dynamos for the agricultural power applications.

It may be interesting to examine a concrete example of an electrically operated farm, and for that we may take the installation lately provided by the Société Helios, of Cologne, for Crottorf, Saxony. The plant is especially interesting because it is designed to serve a number of farms simultaneously.

Crottorf, on the Magdeburg-Halberstadt railway, is in the centre

of the district of Aschersleben. Its wide fertile fields, its extended culture of beets, and its sugar factories, give a characteristic appearance to a region sown with many small villages. The power supplied by the river Bode first suggested the idea of the electric plants we are about to consider. Not far from Crottorf the Bode makes a great curve, cut across by a canal; here was once a mill, and on its site stands now the electric central station.

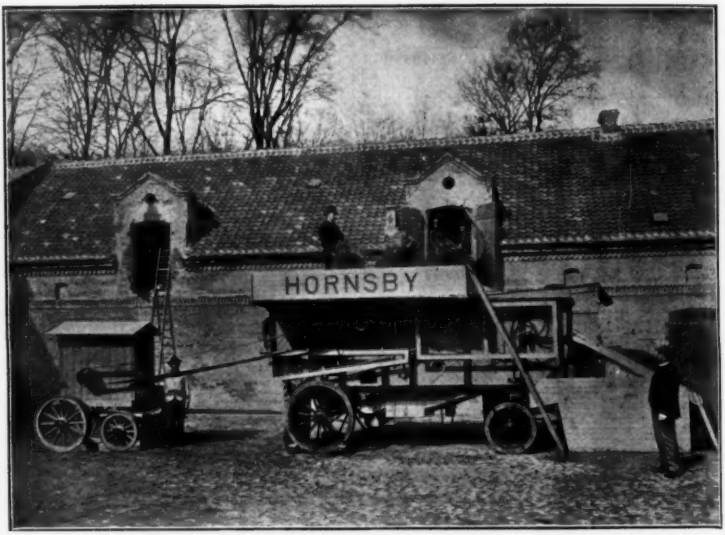
The maximum of power obtainable from the river is 500 horse power. The demands for lighting and motive power in the vicinity and on the neighbouring farms were, however, largely in excess of this, and account must be taken also of the fact that in times of low water level in the river the hydraulic power available would be much smaller. It could serve only as a reserve to the main source, which

HORDORF SUB-STATION, CROTTORF AGRICULTURAL ELECTRIC INSTALLATION.

must be otherwise assured. The presence of a large colliery in the vicinity provided the means of securing the necessary supply at a moderate cost. For electric transformation of the water power, three turbines were installed; with a fall of 2.7 metres and a volume of 6.45 cubic metres a second, each of these develops 185 horse power at

TRANSFORMER HOUSE RAISED ON POLES, CROTTORF.

54 revolutions a minute. All are geared to one shaft, direct-connected to a generator which may also be driven by a steam engine. A second dynamo is installed, driven only by steam. When the river is neither too high nor too low, the turbines can be depended on for a mean of 350 horse power, with a maximum of 500. When the water is insufficient, or when the turbines can not operate, the engine is called upon for a part or all of the needed power. The auxiliary engine coupled to the same dynamo as the turbines is a horizontal compound of 250 brake horse power (metric); the engine connected to the second generator is of 500 horse power. The building housing the plant is large enough to permit the installation of two more units of the same size. Up to the present it is limited to two 500-kilowatt fly-wheel generators of alternating type supplied by the Helios Company; they make 125 revolutions and deliver current at 7,000 volts.



THRESHING MACHINE DRIVEN BY PORTABLE ELECTRIC MOTOR, AT CROTTORF.

PORTABLE TRANSFORMER OF THE CROTTORF INSTALLATION.

The next consideration was the distribution of the high-tension current to the seven districts within a radius of 30 kilometres in which large sales of electricity for lighting and power purposes were expected. The best plan was determined to be in the establishment, in each of these places, of a central secondary transforming station transforming current for both light and power uses. However, where very large demands for lighting current were anticipated, it was thought expedient to separate the lighting and power circuits. It was necessary also to provide for the requirements of threshing machines, the demands of which are sometimes large and sometimes small, but always very irregular. To use the central generators at their full capacity during the day and to employ small apparatus most in proportion to the total ordinary consumption, the large central secondary stations are furnished with accumulator batteries charged by rotaries converting alternating current to direct.

Thanks to the complete separation of the lighting and power circuits, the absolute steadiness of the lights is assured while at the same time all danger from high-tension current on the lighting circuit is avoided. The smaller sub-stations contain static transformers and are housed in with sheet iron.

Efforts have been made at Crottorf to promote the introduction of electric power into farm work, principally the threshing of wheat. The motor is mounted on a vehicle—an arrangement which facilitates bringing the motor near to the machines it is to operate. To permit the attachment of a motor in the fields directly to the high-tension cables, there has been devised a portable transformer which can be attached to the primary circuit by high-tension cables.

The extension of the use of electricity in agriculture depends upon several factors, of which the most important seem to be: 1.—The removal of the repugnance to change manifested by the average farmer; this must be accomplished by education and example, in which Governments and large landed proprietors may be very helpful. 2.—The growth of a spirit of co-operation and association among agriculturists, as thus only could a central station be made economical, or even possible. 3.—The development of auxiliary industries, enabling an electric installation to be operated to greater profit. 4.—The establishment of transportation and communication lines between the many small farms. By these means the use of electricity might be popularised. It is not a consummation to be expected today or tomorrow, but the past is prophecy of the future. Applied science seems capable of all things, and its progress is everywhere tireless.

LIQUID FUEL FOR POWER PURPOSES.

By Arthur L. Williston.

IN a previous article in the May number of THE ENGINEERING MAGAZINE, the use of crude oil or petroleum as a combustible under steam boilers was discussed in some of its mechanical aspects. The efficiency of the liquid-fuel combustion was there shown to depend largely on the character and the design of the furnace used; several typical oil burners of the different types in common use also were described—the successful operation of each depending, it appeared, on the thoroughness with which it atomizes the oil. It was found that in order to obtain the best results and always to secure complete combustion, the oil must be finely sprayed against the incandescent surface of the fire-brick furnace lining or arches, and that small quantities of heated air should be admitted to the furnace at as many points as possible, so as to insure that all of the minute particles of fuel shall come in contact with the quantity of air needed for their perfect combustion, at a point in the furnace where the temperature is sufficiently high to make ignition certain.

In the present article, it is my purpose to discuss oil burning on its economic side, and—as far as possible—to answer the questions: *When does it pay to use oil as a substitute for coal?* and, *What saving in annual expenditure can be expected by such a substitution?*

The great objection to the use of petroleum as the universal fuel is the limited quantity of it available for such use today as compared with the supply of coal, which is practically unlimited, at least for several centuries. The total output of petroleum in the United States for the year 1901 was 69,389,000 barrels—a quantity sufficient to develop more than 3,000,000 horse power during ten hours each day for 365 days in the year. Impressive as these figures are, however, it must be remembered that the greater part of the annual supply of petroleum is, as we shall see later, more valuable for illuminating and lubricating oils than for fuel, and consequently, that no large fraction of the total annual production can, at any time, be consumed as fuel. Nevertheless, the rapid growth in the use of petroleum for fuel during the past two years—especially under stationary boilers in the western and southwest-

ern parts of the United States, and for motive power on the railroads over a much wider area, including nearly all the western States and parts of several of the Gulf States—shows definitely that such a use of oil *does pay* under favorable conditions. The variation in the prices of fuel oil and steam coal in different localities makes it impossible to say when these favorable conditions exist, under which a saving can be effected by the substitution of oil for coal, or what the extent of such saving will be, without working out the problem in considerable detail for each set of circumstances in each locality, basing all calculations on the current local market quotations.

In such calculations of the comparative economy of liquid fuel and coal, two distinct ways will appear in which oil burning may show a saving.

1. Liquid fuel because of its *direct* influence on the annual charges for *fuel, firing,* and *repairs,* may reduce the operating expenses.

2. Liquid fuel because of its *indirect* influence—by so altering the design of the power plant as to reduce its initial cost, when planned to develop a given horse power—may reduce the annual fixed charges for *interest, taxes,* and *depreciation.* Or it may increase the power which is available in the existing plant, thus making additions to its capacity, otherwise needed, unnecessary, which is, of course, practically the same thing so far as its influence on economy is concerned.

The first of these aspects is the particular theme of the present article. The second will be discussed in a following paper in the August issue of this Magazine.

These two possible sources of economy I shall discuss separately, because, in those parts of the United States where the price of oil so nearly equals the relative price of coal that the slight fluctuations which are always likely to take place in the price of either fuel, would make oil burning no longer profitable, it would be necessary to regard the oil installation as of temporary character. In such cases it is proper for us to consider only the first of these two sources of saving; while in states such as Texas and California, where we have every reason to believe that there is an assured supply of oil for power purposes for many years to come, and where, therefore, the oil-burning plant may be regarded in the nature of a permanent installation, we may properly consider both of these sources of economy which I have just mentioned.

The physical properties of the oils used as fuel in the United

States differ widely, but their heating values when burned under steam boilers may usually be taken as a constant quantity for all practical purposes. There is almost no variation in this respect in the crude petroleums from the different wells of the same field, and the difference in the calorific value of the crude Pennsylvania and the crude Texas oils—the two oils that differ perhaps the most in other respects—is very slight. The heating value of crude petroleum will also vary slightly from that of the so-called "reduced" oil, from which the lighter and more volatile oils, such as naphtha and kerosene, have been distilled. It happens, however, that all of the hydro-carbons which are found in the crude petroleums, while differing greatly in specific gravity and in volatility, have carbon and hydrogen present in very nearly constant ratio, consequently the calorific value is practically the same for them all. Thus one sample of Beaumont crude oil gives:

Carbon	84.6 per cent.
Hydrogen	10.9 " "
Sulphur	1.6 " "
Oxygen	2.9 " "

Calorific value per pound, by De Long's formula, 19,060 B. T. U.

An analysis of the reduced oil from the same field from which many of the lighter hydro-carbons have been removed shows:

Carbon	83.3 per cent.
Hydrogen	12.4 " "
Sulphur	.5 " "
Oxygen	3.8 " "

Calorific value per pound, by De Long's formula, 19,481 B. T. U.

The reduced oil appears from these two samples to have a heating power about 2 per cent. greater than the crude oil, when compared pound for pound. The reduced oil at the same price per gallon, however, has a greater advantage over the other from which the lighter oils have not been removed, because it has a higher specific gravity, and there are therefore, with it, more pounds to each gallon. The heavier oil has the additional advantage, too, of being safer in storage and in transportation, as at ordinary temperatures it does not give off gases which might form an explosive mixture with the air.

TABLE I.

	Beaumont, Texas, No. 1.	Beaumont, Texas, No. 2.	Pennsylvania.	Lima, Ohio.	Russia.
Carbon	84.60	85.03	86.10	85.00	86.60
Hydrogen	10.90	12.30	13.90	13.80	12.30
Sulphur	1.63	1.75	.06	.60	.00
Oxygen and nitrogen	2.87	6.00	.00	.60	1.10
Calorific value per pound in B. T. U.	19,060	19,388	202,00[illegible]	20,060	19,500
Theoretical evaporation from and at 212° per pound.	19.7	20.1	20.9	20.7	20.2

Table No. 1 gives the analyses and calculated heating values and theoretical evaporation of five samples of petroleum—two of them from Texas and the remainder from Pennsylvania, Ohio, and Russia. For purposes of general calculation, we may assume any one of the above figures for the calorific value of oil as sufficiently accurate; or for approximate calculations, one pound of either crude oil or reduced oil from any field may be considered as having a heating value equal to 20,000 British thermal units per pound. All of this heat cannot be utilized under the boiler; some of it will be lost by radiation, and a larger quantity will of necessity escape up the stack wih the products of combustion.

If the maximum temperature in the furnace is 2,300 degrees Fahrenheit, and 560 degrees Fahrenheit is the temperature of the escaping gases at the base of the stack, and 60 degrees Fahrenheit that of the atmosphere, then the maximum possible efficiency of the furnace will be:

$$\frac{2300\text{-}560}{2300\text{-}\ 60} = 77.6 \text{ per cent.}$$

Allowing 3 per cent. for radiation losses, there remains practically 75 per cent. as the highest attainable efficiency. If, however, by accurate adjustment of the air supply the maximum temperature of the fire were increased to 2,400 degrees Fahrenheit, and by the use of the economizers or additional heating surface the stack temperature were reduced to 400 degrees Fahrenheit, then the maximum possible efficiency would be:

$$\frac{2400\text{-}400}{2400\text{-}\ 60} = 85.5 \text{ per cent.}$$

Allowing 3 per cent. radiation this would leave an efficiency of 82.5 per cent. It is doubtful if this efficiency is often, if ever, reached. It shows approximately the limit of the possibilities. 78 per cent. has been reached frequently under favorable circumstances, but from 74 to 76 per cent. is probably a more common efficiency in daily practice. Assuming a calorific value for liquid fuel half way between that of the two samples of Texas oil given above, or 19,224 British thermal units, and assuming an efficiency of 78 per cent. for the furnace and boiler, an evaporation of 15.5 pounds of water from and at 212 degrees per pound of fuel is possible. A more probable figure for daily commercial practice, however, is 15 pounds of water evaporated per pound of fuel.

The heating value of a pound of coal is a variable quantity

depending on the kind of coal and on the per cent. of ash that it contains—varying between much wider limits than the corresponding value for the oils that we have been considering. A sample of Pocahontas coal (run of mine) gives the following analysis and calculated heating value:

Carbon	82.26
Hydrogen	3.89
Oxygen	4.12
Nitrogen	.64
Sulphur	.49
Ash	8.60
Calorific value per pound of coal	14,067 B. T. U.
Calorific value per pound of combustible	15,390 B. T. U.

This is a high heating value for a steam coal. The calorific value of other coals will vary, as we shall see later, all the way from this figure to about 9,500 or 10,000 British thermal units per pound according to the coal, the latter figures being average values for western lignite.

In figuring the comparative economy of the two kinds of fuel which we are considering, it is not sufficient to consider their relative heating values alone; it is necessary also to include in the calculations the probable efficiency that may be attained in combustion in commercial practice with each. With the best steam coals it is never possible to get as high an efficiency as is obtained with oil, because a certain percentage of the coal always escapes unconsumed through the grate bars with the ashes, and because, especially with hand firing, the air supply cannot be regulated so nicely with coal as with the liquid fuel. The poorer the quality of the coal, the greater the losses from these two causes will be. Thus with the best steam coals from 68 to 73 per cent. of the theoretical heating power of the fuel is all that may be utilized by the boiler, and it is more difficult to obtain this efficiency with coal than it is to obtain an efficiency 5 or 6 per cent. higher with liquid fuel. 68 per cent. for the boiler efficiency is therefore as high a figure as it is safe to count on in regular service, when good coal is burned; with many bituminous coals 60 to 62 per cent. is a good average efficiency; and with the poorer western coals and lignites, it is difficult to get an efficiency of more than 48 to 55 per cent.

Table II gives the heating power, commercial efficiency, evaporation, and relative value of Texas petroleum and of six different coals with which it is likely to come into competition in different places, for marine, locomotive, or stationary-boiler practice. The figures given in the last column of the table show how much the relative value

of different coals varies when compared with oil. One pound of Texas oil is equivalent to 1.5 pounds of Pocahontas coal or to 3 pounds of lignite.

TABLE II.

Fuel.	Calorific value per pound of coal, B.T.U.	Probable efficiency, per cent.	Commercial evaporation from and at 212°: pounds.	Relative fuel value.
Petroleum (Texas)	19,224	75	15.0	1.00
Pocahontas Coal (run of mine)..	14,067	68	10.0	.66
Anthracite Buckwheat, No. 1.....	13,250	68	8.7	.58
Pittsburg Bituminous	13,060	66	8.5	.56
Indiana Block	12,540	62	7.5	.50
New Mexico and Indian Territory Bituminous	11,300	55	6.0	.40
Western Lignite	96,500	50	5.0	.33

The figure opposite petroleum in the third column of the table gives the total evaporation from and at 212 degrees Fahrenheit without deducting anything for the steam used to atomize the oil. If an allowance be made for this, the evaporation instead of being 15 pounds would probably not exceed 14⅜ or 14½ pounds of steam per pound of oil. This evaporation, it is true, is higher than is attained on an average in the power plants where liquid fuel has been used. It represents an efficiency that ought to be reached, day in and day out, in well designed plants that are properly cared for. The other figures in the same column of Table No. II are, however, based on the same conditions; consequently comparison between them will be fair and may be applied to all plants, whether economically run or not, so long as the same degree of care is exercised when oil is used as has been exercised with coal.

TABLE III.

Tests.	Quality of Oil.	Evaporation from and at 212°, pounds.	Efficiency, per cent.
U. S. Navy Experiments.....	21,000 B. T. U.....	16.9	77.8
Tests made by Engineers' Club of Philadelphia	.....	16.48	....
Tests reported by Prof. Denton	Beaumont Oil, 19,060 B. T. U.....	15.49	78.5
Tests at New Orleans	Texas Oil.....	15.30	77.5
Tests reported in Journal of Franklin Institute	W. Virginia Oil, 20,960 B. T. U.....	16.50	76.0
Tests reported in Journal of Franklin Institute	Texas, Oil, 18,850 B. T. U.....	15.16	76.8
Tests reported by Liquid Fuel Board of U. S. Navy.....	Reduced Beaumont Oil, 19,480 B. T. U....	14.43	71.5

NOTE.—The evaporation given in the last test made by the Liquid Fuel Board of the U. S. Navy was obtained when the boilers were being forced to a point which gave but 6.5 square feet of heating surface for each boiler horse power developed.

Table III gives the evaporation and efficiency results of a few of the tests that have been reported in the technical press, and from them it will appear that the figures assumed for the commercial evaporation with Texas petroleum are not unduly high.

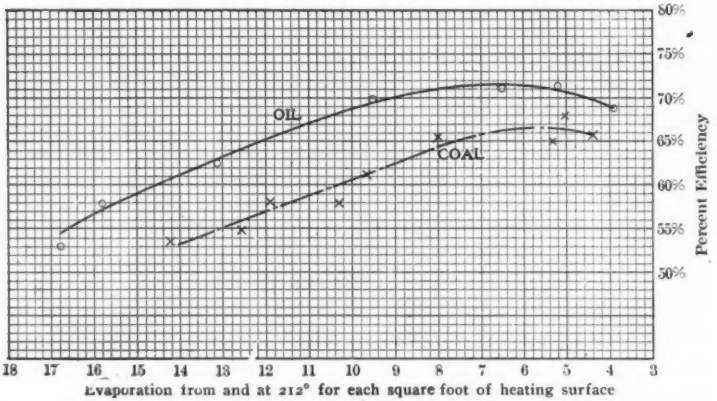


FIG. I. CURVES SHOWING THE RELATION BETWEEN BOILER EFFICIENCY AND RATE OF EVAPORATION FOR TEXAS OIL AND POCAHONTAS COAL. PLOTTED FROM TESTS REPORTED BY THE LIQUID FUEL BOARD OF THE UNITED STATES NAVY.

In Figure 1 are plotted the results of some of the tests made by the Liquid Fuel Board of the United States Navy showing the efficiency in terms of the evaporation per square foot of heating surface per hour for both oil and coal. These curves bring out clearly several points that are of interest. (1) The oil shows an efficiency of about 5 per cent. greater than the coal for the same rate of evaporation. (2) The oil gives an evaporation, or capacity to the boiler, from 15 to 50 per cent. greater than the coal for the same efficiency. (3) The boiler could be forced with the liquid fuel to an evaporation equivalent to a rate of combustion of coal of 85 pounds per square foot of grate surface, or to a point where there was but 2.2 square feet of heating surface for each boiler horse power developed; this is 18 per cent. beyond the point to which the boiler could be fired with Pocahontas coal. (4) The oil showed an efficiency of 65 per cent. when the evaporation was equivalent to a rate of combustion of 56 pounds of coal per square foot of grate surface, or when there was but 3.1 square feet of heating surface to each boiler horse power developed. (5) The maximum efficiency with the oil was attained at a higher rate of evaporation than was the maximum efficiency of the

coal. These results are not exceptional and other tests confirm the conclusions drawn from them. I have selected them for illustration only because they cover a wider range than any other published tests. In the tests reported by Professor Denton, referred to in Table III, an efficiency of 78.5 per cent. and an evaporation of 3.74 pound per square foot of heating surface was reached with oil, as compared with 71.4 per cent. efficiency and an evaporation of 2.22 pounds per square foot of heating surface with anthracite coal—a gain of 7.1 per cent in efficiency and 68 per cent. in capacity in favor of the oil. It is safe to count on a substantial gain in both of these directions when liquid fuel is used.

One barrel of oil contains 42 gallons, and each gallon weighs from 7.40 pounds to 7.90 pounds, according to the specific gravity of the oil. Texas oil weighs 7.66 pounds per gallon, therefore one barrel of it equals 322 pounds and, from the figures given in the last column of Table II, is equivalent for boiler purposes to the following:

483 pounds of Pocahontas coal,
555 pounds of Anthracite buckwheat coal,
575 pounds of Pittsburg bituminous coal,
644 pounds of Indiana block coal,
805 pounds of New Mexico and Indian Territory bituminous coal,
966 pounds of Western lignite.

Or reducing these figures to their equivalent in barrels of Texas oil for one ton of 2,000 pounds of each of the above coals:

One ton of 2,000 pounds Pocahontas coal	= 4.1 barrels Texas oil.
One ton of 2,000 pounds Anthracite buckwheat	= 3.6 barrels Texas oil.
One ton of 2,000 pounds Pittsburg bituminous coal	= 3.5 barrels Texas oil.
One ton of 2,000 pounds Indiana block coal	= 3.1 barrels Texas oil.
One ton of 2,000 pounds New Mexico or Indian Territory bituminous coal	= 2.5 barrels Texas oil.
One ton of 2,000 pounds Western lignite	= 2.1 barrels Texas oil.

From this comparison it is a very simple matter for us to ascertain the total cost for fuel for a steam plant in any locality from the market quotations on either petroleum or such steam coal as is available. But this is not the only item that needs to be taken into consideration in an exact analysis of the comparative economy of coal and liquid fuel. Three other items—the cost of firing, the cost of removal of ashes, and the probable cost of cleaning and keeping in repair the boilers and settings—must also be included.

First, the difference of cost in firing between the two kinds of fuel will depend on the size of the power plant. In very large power plants employing a large force of firemen, experience has shown that one man can tend a large number of oil burners, and that the same man

who is employed as a water tender to be responsible for the water levels in the boilers, can also tend the oil burners of the boilers for which he is responsible. In such plants it is necessary to employ only enough additional men to keep the boiler room clean and to attend to the cleaning of the boilers and to assist in such repairs of boilers and settings as are necessary from time to time. In such a plant, where hand firing has been employed, oil burning will reduce the cost for firing and handling of fuel by at least 75 per cent. In a smaller plant the percentage of economy will not be so great. Thus, in one large establishment on the Pacific Coast where twenty-six firemen, in three shifts, were formerly employed, twelve men are needed since oil has been introduced—a reduction of 54 per cent. On the other hand, in a plant employing only one or two firemen, it would probably be impossible to make any saving whatsoever on this score, because it is always necessary to have at least one man on watch. For the same reason, there is no reduction in the cost of firing when oil is used on a locomotive, although the labors of the fireman are very much decreased, for it would never be safe to run a locomotive in regular service with only one man in the cab.

In order that we may judge how much the reduced cost in firing may effect the total cost, let us make a simple calculation for a steam plant of twenty boilers of 200 horse power each, a total of 4,000 horse power. Such a plant would require three shifts of eight firemen each and two men in charge as water tenders, a total of twenty-six men, at an average cost of about $2.00 per day. The total cost for firing would, therefore, be $54 per day, and the cost per ton of coal for firing would vary according to the quantity of the coal used to develop 4,000 horse power, from 28 cents to 40 cents. As we have already seen, in a plant of this size, there may be a reduction of the boiler-room force of from 55 per cent. to 60 per cent. if oil burning is introduced. This would be equivalent to a reduction of from 16 cents to 24 cents per ton of coal fired.

Second, the cost of removal of ashes will depend on the quality of coal which is used, some coals producing a very much larger amount of ashes to be handled than others. But, as this is a small item, we may properly take an average figure and assume that every 10 tons of coal burned will produce 5 cart loads of ashes that must be removed from the boiler room, carted away, and dumped. This will require extra service besides the regular force in the boiler room and the cost of it will vary according to the particular conditions surrounding each plant, from about 20 cents per load to probably 50 cents per

load, according to the distance which the ashes have to be carted and the scale upon which the work is done. The removal of ashes, therefore, is equivalent to an amount of from 10 cents to 25 cents added to the cost of each ton of coal. But, for the purpose of a general estimate, we may take the average of these two figures and assume that the removal of ashes will be equal to an increase in the price of coal of 17½ cents per ton.

Third, it is very difficult to make an exact estimate of the difference in the cost of cleaning the boilers and maintaining them and their settings in a proper condition of repair, and yet there is no question but what the change from coal to the use of liquid fuel will materially affect all of these items on the balance sheet. With the use of oil, it is possible to maintain in the furnace and throughout the entire boiler setting a combustion so absolutely free from smoke and ashes and so much more nearly perfect than is possible with the use of coal, that the labor of keeping the tubes and the boiler clean will be materially lessened. This will result in a slight saving, but there will, undoubtedly, be a greater saving with the use of oil because of the decreased cost in the repairs of the boiler. There is absolute freedom, when burning oil, from the draughts of cold air which enter the furnace of the ordinary hand-fired boiler every time the fire-door is opened, and which cause temperature strains that tend to produce leaks in the riveted joints and around the tubes in the tube sheet, and that are unquestionably detrimental to the life of the boiler. The saving in repairs from the increased life of the boiler, caused by the freedom from such strains, we cannot exactly estimate in advance, but there is no question but that, in the long run, it will be found to exist. It will be greater in the case of internally fired boilers than with the ordinary multitubular and water-tube boilers, and greater still in the case of locomotive boilers where repairs to the fire-box are always a serious matter. In one plant with which I am familiar, where oil was used continuously for eight years, not a cent has been spent for repairs to any of the boilers and not a sign of a leak or deterioration has appeared—and this is the usual experience where oil has been used for any length of time. The effect of the oil burning on the boiler settings is, however, different. A greater allowance for annual repairs will be needed when oil is used for fuel in place of coal. There are two reasons for this. In the first place, with the oil there is a smaller percentage of the total heat absorbed by direct radiation from the fire to the boiler and, therefore, the average temperature of the furnace and settings throughout their entire length

is higher. This causes a greater total expansion and contraction in the lining of the setting to which the brick work accommodates itself with difficulty. In the second place, the oil is forced into the boiler at high velocity by air or steam pressure, creating a constant vibration in the flame which is sufficient to cause a continual jarring or trembling in the brick work. In the course of time this jarring, together with the expansion caused by the intense heat in the lining, causes cracks in the settings, which, therefore, have to be repaired more frequently than when coal is used as the fuel. The experience of one large plant in this particular may be taken as a fair average of what may be expected. Over a period of years, the repairs to each setting amounted to between $140 and $150 a year. This is almost exactly double what had been paid annually for the same purpose when coal was employed as the fuel. A portion of this increased cost for repairs to the settings is balanced by the decreased cost in repairs to boilers, but I think it proper to allow at least $50 per year for each 200-horse-power boiler in which oil is burned, for the net increase in operating expense under this third heading. Dividing this amount by the number of tons of coal that were needed per year for each 200-horse-power boiler, in order to make the comparison between the cost of coal and oil, it is found to be equivalent to a saving of 5 cents per ton in favor of the coal.

To offset partially the cost of firing with coal, should be charged the expenditure of steam which is necessary to atomize the oil. The amount of this will depend upon whether air or steam is used, the pressure of the atomizing agent, and the efficiency of the burner, but it will generally be found to require from 2 per cent. to 4 per cent. of the total steam generated to operate the air compressor or to feed the burners. In some of the tests reported by the Liquid Fuel Board of the United States Navy, less than 2 per cent. of the total steam was required for atomizing. Tests on the Southern Pacific Railway give from 3.4 per cent. to 3.8 per cent. Other tests which have been reported show about the same amounts. In making accurate comparisons between the cost of coal and liquid fuel, this must be taken into account. In order to make comparisons readily the cost of this atomizing agent should be reduced to the same basis as the cost of firing coal, i. e., the cost per ton of coal burned. If this is done it will be found to equal a saving from 8 cents to 20 cents per ton in favor of the coal.

Summary.—In order to make this comparison more clear, and to show the way in which each of the items that I have discussed affects

the final results, let us make the comparison, first, for a large power plant in New York city with anthracite buckwheat coal at $2.85 per ton of 2,000 pounds in the coal pocket, and reduced oil at 3½ cents per gallon delivered; and second, for a similar plant in California, New Orleans or in Texas with inferior coal at $5.25 per ton in the coal pocket and oil at 55 cents per barrel, delivered.

FIRST: NEW YORK CITY.

Coal.		*Oil Burning.*	
1 ton of coal	$2.85	3.6 barrels of oil at $1.47	$5.29
Firing coal, per ton	.20	Steam for burners	.14
Removal of ashes	.18	Additional repairs	.05
	$3.23		$5.48

Increase in cost with oil burning, 69 per cent.

SECOND: CALIFORNIA, NEW ORLEANS, AND TEXAS.

Coal.		*Oil.*	
1 ton of coal	$5.25	2.55 barrels of oil at 55 cents	$1.40
Firing coal, per ton	.20	Steam for burners	.14
Removal of ashes	.18	Additional repairs	.05
	$5.63		$1.59

Saving in cost with oil burning, 72 per cent.

Between these limits—which by the way are not extreme—are many cases where the increase in cost will not be so much as 69 per cent. or the saving from oil burning will be less than 72 per cent., and at some points in between we shall find places where there will be no difference in cost whatsoever. The two illustrations will, however, serve to show how great may be the saving from the use of oil in certain places and how impossible is its use in many others.

With this summary we may leave the first phase of the economical possibilities of the use of fuel oil, to take up in the August issue the discussion of the second phase, and in connection with it a rapid review of the present and possible output of petroleum in the United States.

EDITORIAL COMMENT

IT has always been a favorite assumption of the Nicaragua Canal advocates that all the possible difficulties of the problem, both physical and political, belonged only to the Panama proposition, while the Nicaragua project was all sweetness and light. In Nicaragua every prospect was pleasing and not even man was vile. On this last point they were especially strong —as much so, indeed, as on the similar one of the alleged superior sanitary claims of Nicaragua. The similarity lies in the fact that both assertions rest on equal bases—rosy assumption in regions where there is as yet absolutely no experimental knowledge by which assertion could be tested. As one skeptical commentator said of the extravagant claims for the healthfulness of the Nicaraguan region, it is difficult to prove or to disprove any alleged vital statistics concerning a district peopled only by monkeys. Nicaragua had not been demonstrated to be unhealthy because no large force of unacclimated persons had ever been at work there. They overlooked or ignored the fact that the absence of disease and death records for Nicaragua was due wholly to the sufficient reason that there had not been people there to get sick or die.

Like inconclusiveness attaches to the other pet assumption—that there would be no political, factional, or local difficulties in the way of completing arrangements with the other Republics if the Panama negotiations were given up in favor of the alternative—an agreement with both Nicaragua and Costa Rica for the necessary concessions and territorial rights for the construction of the Nicaragua Canal. It is not apparent, to say the least, why it should be easier to deal with two petty States than with one; it is still less apparent why it should be easier to deal with them after we had given them a monopoly of the canal-route market by discarding Panama than it is now to deal with the latter State while an alternative remains. But there is another aspect of the case which is even less conjectural, to which scarcely any reference has been made, and in which certain "suppressed disadvantages" of the Nicaraguan project might be predicted with the utmost certainty. These are in all that concerns securing title to the necessary land and concessions, as distinct from questions of treaties or of "sovereignty" over the canal zone or strip.

At Panama there is but one owner to deal with. All titles, whether to land or franchises and concessions, have merged in the single title of the single corporation. But in Nicaragua and Costa Rica the titles and claims are legion. The whole region is plastered with concessions. It is quite certain that if those statesmen whose opposition to Panama took the form of extreme regard for the supposed interests of former claimants to title there should be equally punctilious in the case of Nicaragua, they would go to their long rest before the opposing claims were all filed, and their grandchildren would see the cases, still in full vigor, making their leisurely progress through the slow processes of adjudication.

WE are glad to print the subjoined letter to the editors, for its historic interest in connection with the choice of the route for the Isthmian Canal:

The Editor of THE ENGINEERING MAGAZINE.

Sir—Having read in the June number of the MAGAZINE the communications by Gen. H. L. Abbot and George S. Morison in relation to locks, lakes, and dams for the Panama Canal, I desire to bring to the attention of your readers the plan of the engineers who were with Ferdinand de Lesseps on the Isthmus for fifty days in February and March, 1880, and which was accepted by him, and so the work on the canal begun in 1881, and with few changes continued up to the present time.

I quote as follows from the report, dated Panama, February 14, 1880:

"Fourth Question. *Means to be employed to overcome the difficulties presented by the Chagres River, and of excavating rock below the sea level.*

"The difficulties presented by the Chagres will be overcome, in the first place, by the construction of a dam at Gamboa, between Cruces and Matochin. This work was the subject of a special study conducted by M. Dauzats, *From Gamboa to the Sea.* The commission expresses the opinion that a dam of forty meters in height would provide for the storage of a volume of water 1,000,000,000 of cubic meters, a quantity equal to the maximum estimate of the freshet of November 25, 1879, the greatest that has ever been recorded (1880), as given by Col. G. M. Totten. This work will be completed by the construction of a new channel for the regulated flow of the river from the Gamboa dam to the sea. Another similar but narrower channel will be provided on the opposite side of the canal, for the streams and drainage on that side. As regards the rock to be excavated under the sea level, the commission is of the opinion that no greater difficulties will be encountered than such as are met with in similar work elsewhere, and that the greatest part of the working places can be freed from water by pumping."

The length of the dam at Gamboa was calculated at 1,000 meters.

The report from which I have quoted was signed by the following persons, many of whom are no longer in this world: *G. M. Totten, J. Dirks, E. Boutan, *W. W. Wright, *J. Dauzats, *Pedro J. Sosa, Alejandro Ortega, A. Couvreux, *Fils*, *Gaston Blanchet.

Those marked with an asterisk the writer of this knows to be dead. Abel Couvreux is one of the directors of the present New Panama Canal Company.

NATHAN APPLETON.

New York, June 12, 1903.

* * *

JUST as Col. Stewart's leading article in this issue is coming from the press, the announcement is made of a proposed automobile highway, laid with steel plate rails, to extend the length of Long Island. While primarily conceived for pleasure travel and speed trials, the project contemplates the turning of the road to economic uses also. It is suggested that the road be given over to freight traffic during the night hours, leaving it free to pleasure vehicles during the day. "Motor trucks, moving at twelve miles an hour, could cover eighty-four miles between midnight and seven o'clock in the morning. This would extend the available garden district of the island to double its present length, and, counting a width of five miles, would lead to the clearing, fertilizing, and cultivation of two hundred square miles of land now barren."

This seems to be a sound and useful development of the functions of the business automobile. It is applying it to the sort of duty where its good points all tell, and its shortcomings are least noticeable. It combines the flexibility and the "house-to-house" serviceableness of horse haulage with the long-distance endurance and (partially at least) the speed of the railway. In traffic in which certainty of continuous movement from shipper to receiver is important, and avoidance of rehandling an important object, and in traffic,

moreover, which has always stood a relatively high transportation rate, the automobile ought to find a special field where it can outrival the old alliance of the railway and the teamster. But even here, as soon as a serious development is proposed, it is noteworthy that the motor truck is preparing to follow the advice given in kindly spirit by Col. Stewart and "get onto the roadway its father, the locomotive, found the best."

* * *

IT is very interesting to find, however, that after three-quarters of a century's experience of the conduct of self-propelled vehicles on rails, the opponents of the idea have exhumed the old objections which did duty before the thing had ever been tried. One report is so completely delightful in its innocence of logic and its confusion of ideas that it must be quoted: "Quite an authority on automobile track racing, (who has) held the American championship for some time, . . . said emphatically and without hesitation that a steel track would never work. In the first place, the cars' wheels would not 'bite' the steel, he said, and if they did the car would go so fast it would turn over and kill its driver. He said that no very hard surface would ever prove good for fast going with pneumatic tires. He said he tried to race on the hard sands of the Florida coast, and his car's wheels simply spun around in one spot and threw up great clouds of sand."

But it may be that the opinions of the distinguished authority have not been accurately transcribed, and that to the reporter rather than to the automobilist is due that reminiscent aroma of the tea-party attended by the Hatter and the March Hare.

* * *

WE are glad to give space to the following letter from Mr. Stewart, whose article leads this issue. The letter needs no comment to explain it:

The Editor of THE ENGINEERING MAGAZINE.

Sir—Since the attempted Paris-Madrid race all men have at least a partial realization of the danger of turning locomotives loose; that is to say, running engines on wheels at high speed off of guiding rails; and some will say in regard to that part of my article which points out that danger, that it is easy to be wise after the event, they inferring that the article was written after that race. You might mention that it was written and in print before that race.

The full lesson taught by that contest may be seen when we consider:—

1.—That the automobiles were all going in the same direction.

2.—That the road had been cleared for them by warnings far and wide.

3.—That 10,000 soldiers and police were detailed to keep people out of the way.

4.—That the chauffeurs were men selected from hundreds or thousands for their skill, judgment and nerve.

Yet the slaughter was so great that the French and Spanish governments interfered and stopped the race.

Suppose that the conditions had been those of ordinary traffic—automobiles going in both directions; the road not cleared for them; no army stationed along the route to keep people out of the way; and the vehicles guided by men of average skill, judgment, and nerve. The course would have been a field of blood.

In automobile races on common roads the prizes should not be given to the swiftest vehicle, but to those which at a certain limited speed kill and cripple the fewest people.

In the Paris-Madrid race higher speed was achieved than that quoted in my article, but no higher than has been made by locomotives on rails *pulling trains*. That is to say, the fleetest racer among the automobiles only equals the speed of a heavy draught-horse (iron horse) on the railway, and that draught-horse pulling a load two or three times his own weight.

SYLVESTER STEWART.

REVIEW OF THE ENGINEERING PRESS.
"THE WORLD IS ITS FIELD"

A LABORATORY OF NAVAL ENGINEERING EXPERIMENT.

SCOPE AND PURPOSE OF THE INSTITUTION TO BE ESTABLISHED AT THE UNITED STATES NAVAL ACADEMY.

Rear Admiral George W. Melville.

ECONOMY and efficiency are recognized as dominating considerations in the industrial world. It is highly interesting to note the extension of the same principles into the domain of military engineering—to find them, indeed, supplying the text of a strong argument, by so eminent an authority as Admiral Melville, for the establishment by the United States Government of a naval engineering laboratory. In an address delivered before The Engineers' Club of Philadelphia and reprinted in the *Journal of the American Society of Naval Engineers,* the Admiral outlines the purpose and scope of the proposed laboratory, and in pointing out its importance makes an able plea for the adoption in the navy of that policy of wise expenditure on study and experiment which has been generally accepted by the greatest civil corporations.

The act making appropriations for naval construction for the year beginning July 1, 1903, provides for the building of five battleships which, with armor, armament, and equipment, will cost, the Admiral estimates, about $7,000,000 apiece. The laboratory authorized in the same act, with its equipment, is to cost not exceeding $400,000. Admiral Melville takes as his starting point the small proportion which this outlay bears to the saving it may secure, and his argument is best presented by his own words:

"The annual depreciation of each of these vessels from the time they are launched, taking into consideration wear and tear as well as loss in fighting value, will be at least 4 per cent. of their actual cost. The expense attending the establishment of the proposed experimental station, including its operation for several years, will thus be but little more than the annual loss resulting from corrosion, mishaps, and depreciation of military appliances of two of these floating fighting machines.

"A few hundred dollars spent in well directed and conscientious experiment may result in the saving of hundreds of dollars elsewhere. The cost of maintaining a battle-ship in commission will approximate $1,000 per day, and war-ships have been tied up for weeks on account of the corrosion of a few hundred dollars' worth of boiler tubes. It will repay the nation for the cost of the laboratory if the staff of the laboratory will simply cause increased length of life of both boiler and condenser tubes.

"The rise of Germany as a naval and maritime power during the past thirty years has surprised the world. I believe that her battleships for their tonnage are the best afloat, because they possess a triple-screw installation of machinery, thus giving the motive power of her larger warships economical, structural and tactical advantages over similar high-powered vessels of rival nations. Her ocean greyhounds are the largest, fleetest and probably the most economical and comfortable afloat. Strangest of all, this excellence in the construction of warships, as well as in the building of vessels for the ocean-going trade, is not the result of a progressive series of failures, either in design, construction or of operation.

"The success of Germany can only be accounted for by recognizing the fact that study, reflection and research must have been expended in the preparation of plans, in the building up and the organization of the shipyards, and in laying out and carrying on the work of construction. It was the high appreciation of the value of original investigation, coupled with experimental work, that has caused Germany to advance progressively and successfully.

"For over a hundred years Germany, as a nation, has carried on more original research along technical lines than any other power. While it is true that both England and America have put to practical application the principles discovered by German research, thereby gaining commercial and maritime advantages, it has been the Teuton who has sought after principles, and thus the world is primarily indebted to this studious and thoughtful race for many of the great discoveries and inventions.

"In a desultory and sporadic manner all naval powers have done some experimental work. It is because original investigation is not always appreciated in its fulness by the Anglo-Saxon that many administrative executive officers are indifferent to such research, and therefore experimental tests in Great Britain and America are not always of a continuing nature.

"The cost to the British Government of using the cruisers *Hyacinth, Minerva* and *Hermes* for comparative boiler tests and experiments will approximate more than the cost of establishing and operating both the Charlottenburg and Dresden Stations since their inception.

"If it be true that the battleship of one generation is the junk-heap of the next, then an economical race like the German is pursuing a wise policy in conducting experimental research and investigation in the direction of finding out how the weak links in the naval chain can be strengthened. In the race for naval supremacy it is bullion, as well as brains, that counts.

"Experience has shown that the German engineering laboratories are more than a good paying investment, for there is not an expert in that empire familiar with the work being done at these laboratories who does not believe that their destruction would be a greater national calamity to the navy and the nation than the loss of one of the battleships of the home squadron. The warship could be replaced in four years. It would take six years to rebuild and put in effective operation the complete installation for conducting experimental research that has been developed and perfected at the Charlottenburg and Dresden technical colleges. . . . One does not need to possess vivid imagination to realize that much is contributed to the fighting strength of a navy by carrying on research along engineering lines, and thus preventing the design, construction and installation of appliances that are ill suited for the purposes intended.

"It can be absolutely stated that the navy is behind the times in original work and research. Several months ago one of the marine superintendents of one of the Great Lake Transportation Companies told me that if he was called upon to retrench in expenditures the last item to be cut down would be that for experimental purposes, since both the cost of construction and the expense of operation of the steamers under his control had been reduced as a result of the data secured from experimental work. There is not a leading university, large manufacturing concern, nor great transportation company that does not consider it imperative to make tests and experiments. Every navy will also find that it will increase efficiency and promote economy to conduct and to encourage extended investigation of unsolved problems relating to its marine service."

As to the organization and work of the naval engineering laboratory, Admiral Melville says:

"In collaborating the information received from various sources, the Bureau is of the opinion that the laboratory at Annapolis should in many essential respects be patterned after the Charlottenburg school along steam and material-testing lines; after that of Dresden as repects gas-furnace installations and hydraulic appliances; and after the Swiss school at Zürich in the equipment of apparatus for testing that class of turbines which work under low heads.

"As for the character of the laboratory building and its furnishing, the technical college at Liverpool should serve as a model, since the building of this institution is an

ideal one in many respects, especially as regards light and ventilation.

"The field to be covered by experimental research along engineering lines is vast. The following are only a few of many urgent problems, in the solution of which the navy has a direct interest:

"1. The value of liquid fuel for various naval purposes.

"2. The possibilities of the steam turbine for installation in warships.

"3. The efficiency of various forms of propellers.

"4. The relative advantages and disadvantages of in-turning and out-turning screws.

"5. The reduction of vibration of machinery.

"6. Limits of economical increase of steam pressure.

"7. The development of practical appliances for utilizing the advantages of superheated steam.

"8. A proper ratio of sizes of cylinders for multiple-expansion engines.

"9. Improved systems of economy in auxiliary machinery of naval vessels.

"10. The value of condensed fuel, such as briquettes, etc.

"11. The relative advantages of straight and of bent-tube types of boilers for torpedo boats, gunboats, cruisers and battleships.

"12. The corrosion and deterioration of boiler and condenser tubes.

"13. The relative value of various alloys for machinery purposes.

"14. The types of valve gear most suitable for naval purposes.

"15. The endurance of the storage battery and its possible development.

"16. The more extensive use of steel castings.

"17. The question of lubricants.

"18. Calibration of gauges and of instruments necessary for naval engineering purposes.

"19. The proportions of centrifugal fans.

"20. The most effective systems of forced draft for various classes of warships.

"21. Mechanical refrigeration, the present method of cooling magazines being far from satisfactory.

"22. Testing non-conducting and fireproofing materials.

"23. The determination by actual test of the best proportions of important engine details.

"24. The study of the problem of how to secure more complete and definite information upon trial trips.

"25. Reliable form of water-glass gauge that will be applicable for forced-draft conditions as well as when muddy feed water is used.

"All of the large industrial and transportation corporations maintain complete testing department or bureaus of tests, presided over by experts of national reputation who have under them an ample corps of assistants. The work done at these laboratories in advancing and improving the character of railway and manufacturing appliances has been of great financial gain to the several corporate interests.

"If a private corporation finds it essential to maintain such a testing plant, how much more should the navy—a corporation of far greater size—find the maintenance of such a station profitable for the direct return secured, but likewise necessary for preventing retrogression?"

BRITISH COAL TRADE.

THE GROWTH AND DIRECTION OF THE EXPORT COAL TRADE OF GREAT BRITAIN IN THE LAST HALF CENTURY.

D. A. Thomas—Royal Statistical Society.

IN an important paper recently presented before the Royal Statistical Society, Mr. D. A. Thomas, M. P., discussed the relation of the export coal trade of Great Britain with reference to general industry and manufactures, and some abstract of the paper is here given.

During the fifty years between 1850 and 1900, the quantity of coal produced in the United Kingdom and retained for home consumption more than trebled; or regarding it *per capita*, about doubled. In the same period the quantity exported, including that shipped for steamers' use, increased

about fifteen-fold, rising from 6.8 per cent. to 26 per cent. of the total output. Considered from a commercial standpoint, these figures may be found very satisfactory, but the possible want of permanence, and the ultimate influence of the export of a natural resource upon national prosperity must be considered.

It is naturally maintained that a corresponding equivalent must come into the United Kingdom in exchange for the value of the coal exported, but Mr. Thomas points out that the money value of the coal is not altogether the index of its importance to the nation, since a large proportion of its cost goes in labor. The winning of the coal exported occupies about 200,000 colliers, apart from the railway and dock hands who handle it, while in 1900 it was estimated that about twenty millions sterling was paid to ship owners for freight.

Much has been said about the dependence of the United Kingdom upon foreign countries for its food supplies, but the weakness of this position has been fully overcome by the possession of coal, which has enabled Great Britain to maintain her commanding position in spite of the fact that a large portion of her food comes from over sea. With the exhaustion of the coal supply, however, this position will necessarily be changed, and although it is possible that other sources of energy will be discovered and utilized, these will doubtless be shared by other nations to an extent which will deprive England of a portion, at least, of her pre-eminence.

While the importance of this question must be admitted, it is impossible to see how the possibilities of the future can be mitigated. Any attempts at the restriction of export can produce but a partial remedy, and, in fact, would be almost impracticable. Every successful attempt in the reduction of the cost of production, and every increase in the economy of consumption, must extend the field of its use and so stimulate the general demand.

Naturally, the great demand which has arisen for coal has been due to the wide extension in the use of steam during the past fifty years. A very large proportion of the British coal which has left the Kingdom has been required for the purposes of steam navigation, in connection with the enormous growth of over-sea commerce with all parts of the world. In this connection it is interesting to observe that by far the greater portion of the coal leaving the United Kingdom has not been for consumption in other countries, but for use in vessels carrying the British flag. Nevertheless, the coal is being consumed and the home stock is continually growing less, and thus the national capital is steadily being used up. It is not necessary that British coal supplies should be entirely consumed before British supremacy is imperilled, since the increase in depths must cause an increase in cost which will begin to be felt long before the carboniferous measures are exhausted.

Viewed from the other side, however, the export of British coal forms a most important element in commerce. Considered as cargo for outward-bound ships, it constitutes more than four-fifths of her exports, and without it the great bulk of the shipping bringing in such staples as cotton, corn and wool would be obliged to clear in ballast for lack of sufficient cargo.

Mr. Thomas emphasizes the fact that the discussion of the coal question by the late Professor Jevons has been fairly well confirmed in the light of modern fuller knowledge. The experience of thirty-five years has proved his main conclusions to be substantially true, minor details only being subject to slight modifications.

So far as other parts of the world are concerned the coal question, while important, has not the national significance which exists in Great Britain. The coal strike in the anthracite regions of Pennsylvania caused temporary inconvenience in many places where bituminous coal is not used, but the supply of the latter in the United States is practically inexhaustible, and with proper provision for its complete combustion, it may readily be substituted for anthracite when occasion may require. Besides the United States, the coal measures of Canada and British Columbia must be remembered, together with the deposits in Alaska and in Japan, as well as the enormous strata in China. There is no fear for the coal supply of the world, but as for the United Kingdom, her coal resources may well demand just such a careful study as Mr. Thomas has given them.

TIMBER FOR RAILROADS.

THE ECONOMIC USE OF TIMBER BY RAILROADS AND THE IMPORTANCE OF ITS PROPER PRESERVATIVE TREATMENT.

Dr. Hermann von Schrenk—Prof. B. E. Fernow.

THE daily papers have recently chronicled the fact that one of the principal railroads of the United States has made arrangements with the National Bureau of Forestry to conduct extensive practical experiments in the use of ties made of the cheaper and more accessible kinds of wood, treated by preservative processes. The scarcity of the supply and the increase in the price of wood which, in its natural state, is suitable for ties, have forced the railroads to look into the possibility of utilizing local supplies of timber which has hitherto not been available, owing to its rapid deterioration.

The experts of the Bureau of Forestry have been urging the economic advantages of the preservative treatment of timber for ties, telephone and telegraph poles and other purposes for many years, and elaborate experiments along these lines have been, and are being, carried on, notably at the United States Government Experiment Station at St. Louis, under the direction of Dr. von Schrenk. This missionary work is beginning to tell, and railroad men are paying more serious attention to the exhortations of the forestry experts, and are coöperating with them in a practical way.

This favorable condition of affairs lends particular interest to two papers which were recently read before the New York Railroad Club, one by Dr. Hermann von Schrenk on "The Use of Timber and Its Relation to Forestry," and the other by Prof. B. E. Fernow on "Railroad Interests in Forest Supplies."

Dr. von Schrenk considers the following main points: 1. The present use of wood and where it comes from. 2. What we may expect to get some years hence. 3. Probable methods to be adopted for assuring a constant and adequate future supply of timber.

The railroads employ wood to-day for ties, bridge materials, fence posts, piling, and telegraph poles, and for buildings and cars. The timbers used for these various purposes are of all kinds, but chiefly white oak and chestnut in the East, and various pines in the West for ties, locust, chestnut and cedars for fence posts and telegraph poles, and yellow pine and Oregon fir for bridges. The sources of the present timber supply are more narrow than they were in the past. When large forest tracts were to be found in almost every State, the timber was mostly cut locally, but now, although some wood is thus secured, the larger quantities come from a distance. Pine from Georgia and cedar from Canada are sent to the railroads about New York, the roads in Iowa haul oak 700 miles, and one road in Colorado brings pine from southeastern Texas.

If present methods are allowed to continue unchecked, the local growths of suitable timber will be entirely exhausted for most of the railroads, and they will have to go to greater and greater distances in order to get supplies. Even the great forests still standing in remote parts of the country will not be able to meet the demand upon them indefinitely, and although they may hold out for a good many years, the higher prices of timber and the increasing uncertainty as to getting the quantities and kinds desired have directed the attention of those in charge of the management of large interests dependent more or less on forest products to the possibilities of re-establishing a safe and lasting local supply, with increased service obtained from the timber, all of which means forestry in its best sense.

The methods by which this end will probably be reached are: 1. Proper management of existing tracts of forest lands so as to yield a constant supply without destroying the forest. 2. Re-planting cut-over or treeless areas not fit for agricultural purposes. 3. Timber preservation, involving the chemical treatment of timber to obtain longer life, and consequently insuring the cutting of smaller quantities from the existing forests.

Up to the present day lumbering operations in the United States have generally

been carried on from the standpoint of realizing the greatest amount from any given forest tract without regard to future operations, but the time has come when very different lumbering will have to be resorted to, and not merely because of sentiment, but for reasons of sound business policy. A forest consists of trees of the same or different kinds which grow continuously from year to year, and every year the amount of timber on a tract increases in quantity and consequently in value. Some trees grow faster than others, but at a certain period in its growth, a given tree will reach its point of maximum value. Suppose, now, that instead of cutting off the whole forest at any one time, only such trees as have reached this point of maximum value are cut, and the remainder allowed to grow until they also have reached their corresponding maxima. Given a forest tract of sufficient size, on which young trees are constantly replacing those cut out, it will be evident that continuous cutting can take place on such a tract, without destroying the forest as a whole. When we know the rate at which any given trees grow, it becomes a comparatively easy matter to determine with some degree of accuracy what one can expect in the way of returns from a tract year after year.

It is according to this system that the forests of Germany, Switzerland, and other European countries have been worked for many years, and such lumbering is bound to come in the United States. In fact, it is already being tried, in a tentative way, by some large timber operators and on some private estates.

The second method for producing future timber supplies consists in planting trees on areas which as a rule are not fit for agricultural purposes. This can be carried out to a limited extent by individuals, but it can be done best on a large scale by governments and great corporations which can afford to wait many years for a slow but sure return on an investment.

The third method which will aid in assuring a future supply of timber consists in preserving the wood against decay, wear and fire. In order that timber preservation shall be economically as well as technically successful, the following questions must be considered and rightly answered: 1. What timbers ought to be preserved? 2. What preserving methods should be used? 3. How should the preserving be done? 4. Who should do the preserving?

The value of any particular wood for tie purposes has so far depended largely upon its power to resist decay. The most valuable timbers, like the white oak and the long-leaf pine, were used because they lasted longer than others, which meant a saving in the renewal costs great enough to warrant a high first cost. For present purposes such woods may be spoken of as high grade, to distinguish them from those that are short lived when in use, like red oak, loblolly pine and hemlock, timbers which it has not paid to use hitherto because of the necessity for frequent renewals. The high-grade timbers are, as a rule, dense, hard woods, which absorb water slowly, and for this reason, and possibly also because of the presence of antiseptic substances, are not as rapidly attacked by wood-destroying fungi. The injection of chemicals into timber does away with this distinction and sets up another. The longest lived preserved timber (speaking with reference to resistance to decay alone) will be the one which will allow of the most perfect and even penetration of the preservative, and which at the same time will hold such a preservative. Long life alone, however, is not the prime consideration, but rather the greatest return on the original investment, which consists of the first cost of the timber and the cost of the preservative process. It so happens that the open-grained, porous woods which, when untreated, last but a comparatively short time, allow a deep penetration of the preservative and thus have their life greatly lengthened, while the denser woods, which ordinarily are called long lived, resist the penetration of the preservative and gain only a little in the length of their life as a result of treatment.

The experience of the Eastern Railway of France confirms these statements: Untreated oak ties gave this railroad an average life of twenty years. The treatment added five years to this. Untreated beech lasts about four or five years, while the treated beech has so far given an average life considerably over thirty-five years.

It so happens that porous timbers, as a rule, come from rapidly growing trees, which means short periods of rotation of a forest under management, and consequently a definite and sure future supply; and, moreover, these timbers are still plentiful in most sections of the United States and are easily accessible to the railroads. It will thus be seen that all circumstances combine to make the cheaper, short-lived timbers the most suitable for treatment by a good process, and for subsequent use.

Dr. von Schrenk enumerates the principal preservative methods, as follows: 1. Creosoting or tar oil treatment. 2. Burnettizing or treatment with zinc chloride. 3. A combined zinc chloride and tar oil treatment in its various forms. 4. The Hasselmann process, or boiling in copper-iron aluminum sulphate. There are other processes, which are being experimented with, but which have not been in use long enough for conclusive data to be derived from them.

To get good results, great care should be taken in the preservative process, and the timber should be thoroughly seasoned before treatment. The work should be in charge of competent men, and it would be advantageous for a railroad to organize a forestry and timber department, with an expert at the head of it.

Prof. Fernow confirmed Dr. Schrenk's statements as to the wastefulness of former lumbering operations and the necessity for more scientific and rational methods in the future. He also believes that preserved ties will be much more economical in the long run than untreated ones, and for renewal purposes, on roads already built, he advocates the use of preserved ties. But he thinks that even the preserved tie must ultimately give way to the metal tie, which will be the tie of the future, and which should now be employed in new construction.

These papers and the ensuing discussion before a large body of practical men, are evidence of the intelligent interest which is now being taken by some of the great railroads and telephone companies in economic forestry and timber preservation, and give promise that the remaining supplies of timber in the United States will not be wastefully used up, but will be regarded as a great source of national wealth which must be carefully administered for the benefit not only of the present, but of all future generations.

ELECTRIC FURNACES.

THE PRESENT STATUS OF THE ELECTRIC FURNACE IN METALLURGY AND SMELTING OPERATIONS.

Albert Keller—Iron and Steel Institute.

NUMEROUS attempts have been made to utilize the electric furnace for general smelting purposes, and many claims, some of them extravagant enough, have been made for various devices. For this reason the paper of Mr. Albert Keller, presented at the recent meeting of the Iron and Steel Institute, is to be welcomed, since it gives in a reliable and authoritative form the present claims of the electric furnace to be considered as a practical metallurgical appliance.

As is well known, the electric furnace has been used almost exclusively for the reduction of such refractory materials as resisted the lower temperatures of ordinary furnaces. Examples of such applications are found in the production of calcium carbide, of carborundum, artificial corundum, and the like, as well as for the reduction of metallic aluminum, involving the use of the electric current as a reducing agent. These applications have been made upon a large scale, the utilization of hydraulic power for the generation of the current having been applied especially to the manufacture of calcium carbide between the years 1894 and 1901. The crisis in the calcium carbide industry, however, caused many plants to be idle, with the result of stimulating efforts to apply the apparatus to other departments of work. It was found, however, that modifications were necessary in the furnaces in order to adapt them to general metallurgical purposes, since the hearths which served for the conductors of the current were made of carbon, and the metals or alloys to be reduced would

absorb an excessive proportion of carbon, almost impossible of elimination afterwards.

Mr. Keller discusses these modifications at length, showing how the electrical furnace, from being a special apparatus, with its applications closely limited, has become a metallurgical adjunct of greatly enlarged scope.

Electric furnaces may be divided into four classes. The first and oldest of these includes the various forms of electric arc furnaces, in which an arc is produced between two electrodes or between one or more electrodes and the hearth. In these furnaces the heating is effected by the direct heat of the arc, and it is impracticable to fill them up with the material, so that this type is not adapted for the reduction of ores. Such furnaces, however, are well suited for the fining of metals, and they have been successfully employed for such work.

The second class includes electric resistance furnaces, in which the electrodes are immersed in the material in the process of fusion. Here the temperature is in proportion to the surface of the electrodes, and a distribution of the calorific action can take place over extensive surfaces, depending solely upon the power absorbed. This style of furnace is especially adapted for the reduction of ores, since the control of temperature during working is a simple matter, and the liquid metal can always be run off at the lower part of the furnace. The action of such furnaces is similar to that of a blast furnace, the hot zone of the tuyeres being replaced by the mass intervening between the two poles.

In the third class is found what may be called surface resistance furnaces. In these the electrodes alone do not afford sufficient section for the passage of the current, and it is necessary to connect them by means of some conducting material, such as a bed formed of pieces of carbon. This bed is thus brought to a state of high incandescence, forming a melting hearth upon which the material is placed. This type of furnace may be used, fully charged, for the reduction of raw material, or it may be employed for fining a metal or alloy by arranging the electrodes so that they hang just above the molten material, but are not immersed in it.

The last class contains what are called electric induction furnaces. These are in the form of an annular crucible, the contents of which form the secondary circuit of a transformer, the primary circuit being arranged in the ordinary way. Such furnaces, which are by no means new, have but a limited application in practice, but are available for the fining of liquid charges of metal in the crucible.

By far the most interesting portion of Mr. Keller's paper is that describing the works of the Thermo-Electric Company of Paris, in operation at Livet, in the valley of the Romanche. Here there is a flow of 25 cubic metres per second, with a head of 64 metres (210 feet), giving a total of more than 20,000 horse power available, although but a portion of this is at present utilized.

The operations at Livet include the use of electric blast furnaces and electric fining furnaces, the former reducing the iron from the ore, and the latter converting the molten charge into steel. In general appearance the blast furnace resembles the ordinary high-furnace with the addition of a large hearth below, and without the usual contraction at the boshes. Four large carbon electrodes enter the furnace at the hearth level, while the shaft above contains the ore, fuel and flux, as in the ordinary blast furnace. When the furnace is started the fusion and reduction takes place, at first only upon the hearth, but after working for some time the materials contained in the upper part become sufficiently heated to enter into reaction. It thus appears that the work is done partly by the electric current and partly by the fuel, there being no blast, and the heat of the fusion zone being entirely supplied by the electricity.

The molten metal from the high-furnace is drawn off into the fining furnace, this containing only a partial charge, the electrodes not being plunged into the bath but suspended above it so as to be clear of the slag. The process is similar to that in the open hearth, except that the mode of heating is neutral. The decarburization is effected principally by the aid of metallic oxides, and the product closely resembles crucible steel.

Mr Keller gives cost of the plant, which, including a depreciation of one-tenth per an-

num, entails an establishment charge of 20 shillings per kilowatt-year. To this must be added the operative charges, the ore being 10 shillings per ton, and containing 65 per cent. of metallic iron, and the cost of coke being 48 shillings per ton. He concludes that electric smelting cannot compete successfully with existing methods when the cost of electrical energy exceeds 25s. 6d. per kilowatt-year, but shows that this cost may be reached in situations where water power is available.

The works at Livet is an installation where the electric smelting of iron and the production of steel has been undertaken on a far larger scale than elsewhere, and as such it is worthy of notice.

In view of the superior quality of the steel produced in the electric fining furnace, it is probable that the process may find extended application, using molten pig-iron from the ordinary blast furnace. In this case the cost comes within practicable limits, and the character of the product renders the commercial side of the question one which will bear examination.

CLIMATOLOGY OF THE ISTHMUS OF PANAMA.

A SUMMARY OF THE METEOROLOGICAL CONDITIONS AFFECTING THE CONSTRUCTION OF THE CANAL.

Gen. Henry L. Abbot.

A RECENT contribution to the *Monthly Weather Review* is noteworthy not only for the distinction of its author and the thoroughness of its analysis of meteorological data, but also as affording the most complete development yet attempted of the conditions which must be met and controlled in the building of the Isthmian waterway. It is in this connection that General Abbot undertook the analysis of the statistics available to date as the result of the work carried on during twenty years past by the two companies operating on the Isthmus. Regrettably, only the barest outline of the entire study can be given here, and none of the interesting and valuable tables.

"In considering the climate of the Isthmus," says the General, "as compared with that of more temperate regions, attention is attracted by the remarkable uniformity of temperature throughout the year.

"The general elements which determine this uniformity are the direct heat received from the sun; the influence of the excessive volume of aqueous vapor held in suspension in the atmosphere; the influence of the two great seas which wash the shores of the narrow belt of land constituting the Isthmus. The influence of the seas depends on their varying absolute temperatures and on the movements of the atmosphere, as these, in a large measure, regulate the effect of the oceans in different months.

"The relative intensity of the solar energy received during the month may be regarded as proportional to the sine of the altitude of the sun at noon, and its relative duration as proportional to the length of the time that it is above the horizon on that day. It is, however, to be noted that the length of day, and hence the duration of solar radiation, attains its maximum in June and its minimum in December; and that this element therefore tends to reduce the natural fall of temperature during the northward journey of the sun, and to augment it during the approach to his southern limit.

"But the temperature of the air, as registered by the thermometer, is affected by the modifying influence of the aqueous vapor held in suspension, which opposes great resistance to the energy radiated from the sun by day, and still more to that radiated back from the earth both by day and by night. By day this vapor tends to largely reduce, and by night to largely increase, the temperature of the air at the earth's surface.

"It remains to consider the influence of the two oceans bordering the Isthmus. The old canal company made daily observations of the temperature of the water at Colon and at Naos for four years, from 1884 to 1888. At Colon the annual average was 79.3° F., the maximum, 81.9°, occurring in September, and the minimum, 75.8°, in February. At Naos these figures were 76.1°, 80.0° occurring in October, and 67.80° in February. The general movements of the at-

mosphere, which in a large measure determine the influence of oceans upon neighboring shore climates, are here governed by the locus of the ascending current of warm air which follows the sun in its travels north and south between the solstices. When the sun is north of the Isthmus southerly winds prevail, and when south, northerly winds.

"As is the case with monthly means, the changes of temperature from hour to hour and from day to day are subject to much less variation on the Isthmus than in regions more remote from the equator. Alhajuela is situated in the valley of the upper Chagres, among the hills which here represent the great mountain chains bordering the western coast of North and South America. Its altitude above tide is only 144 feet, and being about midway between the oceans the locality is well suited to represent the climate of the interior of the Isthmus. The temperature at sunrise in the dry season is about 72°; it soon rises rapidly, attaining about 87° at 1 p. m.; after this it falls rapidly to about 81° at sunset, and then subsides gradually to the minimum at sunrise. During the rainy season the temperature at sunrise is about 74°; it rapidly reaches a maximum at noon, about 85°, and then falls to about 80° at sunset, and later to the minimum at sunrise. Thus, during the dry season the daily temperature has a larger range and a later maximum than when rains prevail.

"At La Boca, situated on the Bay of Panama, the minimum temperature occurs later, or at about an hour after sunrise, being then about 75° in both the dry and the rainy seasons. The maximum in the dry season, 86°, is reached at about 4 p. m., and in the rainy season, 84°, at about half past 2 p. m. The rate of fall is more gradual than at Alhajuela, the mercury receding at sunset in the dry season only to about 86°, and in the rainy season only to about 83°. In short, the changes on the Pacific coast are less extreme and are later than in the interior, but the daily average is about the same.

"An annual rainfall of about 140 inches may be expected on the Atlantic coast, about 93 inches in the interior, and about 60 inches near the shores of the Pacific. There is a well-defined dry season beginning in December and including the months of January, February, March, and part of April, a period during which the sun is returning northward from his southern journey to the Tropic of Capricorn, and the locus of heavy rainfall has been transferred southward from the Isthmus. This comparative exemption from rain is characteristic of the interior and of the Pacific coast, but somewhat less so of the region bordering the Caribbean Sea. Clearly, it is an important advantage to be able to depend upon having several consecutive dry months in which to prosecute the laying of concrete and other difficult work during the construction of the canal.

"The health statistics during the construction of the Panama Railroad have never been made public, but are well known to have been appalling. At that date it was not understood that natives of the temperate regions can not safely perform arduous manual labor under exposure to a tropical sun, and that dependence for such work must be placed upon the negroes of the West Indies. White men can supervise, but must not attempt more. Fortunately the health records during the canal operations, and especially those during the operations of the new company, which should furnish the best guide in view of the great changes in the physical condition of the region, have been preserved. Dr. Lacroisade, for many years the medical director of the fine company hospital near Panama, is thoroughly familiar with the Isthmian conditions, and the notes following are a translation from a letter written by him. He attributes marked improvement to the better accommodations of the laborers, to better drainage, and especially to the fact that the excavations have reached a level below the poisonous emanations of decaying matter in the soil."

From Dr. Lacroisade's letter, which follows, we summarize these general conclusions:

"Considering the average figures for the last four years, I find that with a personnel of 2,275 the percentage of disease has been 29.65, and the mortality 2.35 per cent. These figures do not exceed those on large works in any country.

"It should, however, be added that this personnel has been long on the Isthmus and is well acclimated; I may even say extreme-

ly so, since 91 per cent. of the total death rate is due to chronic organic diseases common to all countries, leaving only 9 per cent. of it chargeable to the diseases of the local climate.

"The classified employees, which constitute about 8 per cent. of the entire force, are represented in the total death rate by 5.70 per cent., while the laborers are represented by 94.30 per cent. The mortality in the latter class is therefore the greater.

"Among infectious diseases on the Isthmus yellow fever is undoubtedly the most to be feared by unacclimated persons of the white race. During the two recent epidemics of yellow fever—the first from May to December 15, 1899, and the second from March to September 10, 1900—only two cases appeared among the personnel of the company.

"I have mentioned in former reports the disappearance of yellow fever from the Isthmus from the year 1892 to the year 1897. This would lead to the belief that the disease is in no wise necessarily endemic.

"I will remark that the City of Colon, which up to about the years 1891-92, was a terrain than which nothing could be better for yellow fever—reputed more dangerous than the City of Panama—has since that time remained free from any infectious disease and has escaped the yellow fever epidemics of 1897, 1899, and 1900. This is evidently due to the sanitary works which have been executed, the filling up of the many little swamps and the cleaning of streets which before were veritable sewers. By these improvements the City of Colon has been considerably freed from the swarms of mosquitoes which rendered life insupportable.

"Might not a like result be secured for the City of Panama (1) by a good supply of pure water, (2) by drains to conduct sewerage to the sea, to which its situation and conformation are easily adapted, and (3) by watering the streets daily in the dry season, and by cleaning them daily throughout the entire year. Now they are in a repulsive condition of filth. These three improvements, which I consider fundamental and essential, are now wholly neglected.

"There should also be instituted an effective quarantine service for vessels arriving in the harbor, for beyond all doubt the epidemics of 1897, 1899, and 1900, and the few cases which occurred in January, 1901, were due to importations, in one instance from the Atlantic and in three instances from the Pacific.

"I do not expect by these measures to remove completely from Panama its character as a terrain favorable for the propagation of yellow fever; but certainly, if thoroughly applied, they would exclude some epidemics and render a residence on the Isthmus less dangerous for unacclimated persons of the white race.

"The important works executed from one end to the other of the line of the canal have also done much to improve the sanitary conditions existing on the Isthmus."

THE ACETYLENE BLOWPIPE.

APPLICATIONS OF THE THERMAL EFFECT OF THE OXYGEN-ACETYLENE BLOWPIPE IN THE MECHANICAL AND INDUSTRIAL ARTS.

André Binet—Le Génie Civil

THE uses of high temperatures in the arts have continually extended with the improvements in the means for producing them. Thus the heat of the electric arc has been applied in the electric furnace, some of the latest developments of which are discussed elsewhere in these columns. The aluminothermie of Dr. Goldschmidt is another example of the manner in which the high temperature of a chemical reaction is used for welding and fusing refractory metals, while the oxy-hydrogen blowpipe has long been employed for various purposes involving the effects of concentrated high heat.

All these methods have their limitations, however, the process of the combustion of aluminum being adapted principally for the joining of rails, the repairing of castings, and similar work, while the electric furnace appears to have found its most effective use in the manufacture, on a commercial scale, of such articles as calcium carbide, carborundum, and the like.

The most recent appliance for the production of a very high temperature in a form suitable for employment in the arts is the oxygen-acetylene blowpipe, and from a paper by M. André Binet, in a recent issue of *Le Génie Civil,* we abstract some account of the apparatus and its operation.

The oxy-hydrogen blowpipe is well known to be produced by the combustion, under pressure, of the gases oxygen and hydrogen, in suitable nozzles, the best results being obtained when the combination is that corresponding to the formation of water, or two parts of hydrogen to one part of oxygen. Various attempts have been made to determine the temperature produced by such a blowpipe, one of the earliest of these being by M. Sainte-Claire Deville, based on the cooling of a mass of platinum heated in the jet, the result being an estimate of about 2500° C. Later experiments, by Bunsen and by Mallard and Le Chatelier, have materially increased this value, the present accepted figures being about 3,300° C. The variations may be due to the various mixtures of the gases actually combining in the jet, there generally being an excess of hydrogen present, owing to the usual objection to the production of an oxidizing flame, while at the same time the abstraction of heat from surrounding objects acts materially to reduce the temperature, so that the available heat is less than would be expected from theoretical considerations. In practice it is found that the oxy-hydrogen blowpipe is unsatisfactory for the welding of pieces of steel of even moderate size, while the cost of gas becomes excessive.

Modern methods of the production of acetylene gas have results in attempts to use it as a special fuel in the arts, and among these the acetylene blowpipe offers some interesting possibilities. The calorific power of acetylene is very high, being far superior to that of an equal volume of hydrogen. Thus, the combustion of one cubic metre of hydrogen disengages about 3,100 calories, while a cubic metre of acetylene produces 14,500 calories. By the substitution of acetylene for hydrogen in the blowpipe, using acetylene and oxygen in the proper proportions, and under a much lower pressure than when hydrogen is employed, a temperature exceeding 4,000° C. is obtained in a satisfactory working form. This alone would be a most important result, but to this is added the fact that the oxygen-acetylene blowpipe is much cheaper than the oxy-hydrogen apparatus.

In the case of the oxy-hydrogen blowpipe the two gases are generally contained in strong cylinders, under a pressure of 12 to 15 atmospheres; reducing valves being provided in order to enable the proper working pressure at the jets to be maintained. With the use of acetylene, however, this arrangement is modified, the oxygen only being contained under pressure in a cylinder and the acetylene delivered directly from the generator at the working pressure.

A special advantage resulting from the employment of acetylene in the blowpipe is the ease and certainty with which the flame can be regulated. The colorless nature of the hydrogen flame renders it difficult to determine the proportions of the gases by inspection, but the brilliant illuminating power of the acetylene enables the effect of the admittance of varying proportions of oxygen to be estimated very closely by observation. This fact enables the skilled operator to produce an oxidizing, neutral, or reducing flame at will, thus greatly facilitating the use of the blowpipe for metallurgical operations.

The extent to which the oxygen-acetylene blowpipe may be employed in actual shop work is indicated by examples given by M. Binet, these including the direct welding of flanges upon steel pipes, the joining of pipes at various angles, and the like, and there is no reason why it should not be used for welding joints in boiler shells or in ship construction, since the portability of the apparatus enables it to be applied at any point in a structure with convenience.

Tests which have been made of the strength of welded joints in which the oxygen-acetylene blowpipe was used have given very satisfactory results. A tension test of two pieces of steel welded by the blowpipe showed an ultimate resistance of 35 kilogrammes per square millimetre (49,770 pounds per square inch), and in general the results of the work are fully equal to those obtained by electric welding.

As in the case of the oxy-hydrogen blowpipe, it is difficult to determine the exact

temperature produced by the combustion of acetylene with oxygen in the blowpipe, since the effects of cooling, dissociation, vaporization, etc., modify the result. The experiments of M. Le Chatelier, however, show that a temperature of at least 4,000° C. is reached, and it is certain that all the metals used in the arts are instantly fused by use of the oxygen-acetylene blowpipe, burning in free air.

PORTLAND AND SLAG CEMENTS.

A STUDY OF THE MANUFACTURE OF PORTLAND CEMENT FROM BLAST-FURNACE SLAG, IN EUROPE.

Iron and Steel Institute.

AT the recent meeting of the Iron and Steel Institute, one of the papers which elicited an active discussion was that presented by Chevalier C. de Schwarz, of Liége, upon the manufacture of a true Portland cement from blast-furnace slag. Ordinary slag cement, as has been frequently described in these columns, is made by grinding to a fine powder a mixture of about one-third to one-fourth of slaked lime with two-thirds or three-fourths of granulated blast furnace slag. Such a cement, in which the mixed materials are not subjected to a subsequent calcination, cannot properly be termed a Portland cement, and while it may be available for certain limited uses, it can only be advantageously employed for structures under water, or for foundations, and not for works which are exposed to the free air or to the rays of the sun.

Referring to chemical composition, it has been found that in a true Portland cement the proportion which the total lime plus magnesia bears to the silica plus alumina is about 2 to 1, while in the case of ordinary slag cements the proportion is about 3 to 2. Nevertheless, slag cement is extensively used both in Germany and in the United States, and its manufacture, mainly as an adjunct to iron and steel works, is steadily increasing.

The principal cause of the disadvantages of ordinary slag cement as compared with Portland cement appears to be the fact that the action between the lime and the slag takes place when the constituents are cold and not when in the fire, as is the case with Portland cement. The calcining of the materials together appears to increase the affinity between the silica and the lime, while in the case of the slag cement this action fails.

In order to remedy the defects of ordinary slag cement the natural idea is to calcine the limestone with the granulated slag, and this has been developed in Germany with great success. After a number of experiments, success has been attained in the manufacture of Portland cement from blast-furnace slag by mixing granulated slag with limestone in the same manner as is done with the materials used for making Portland cement—that is, by calcining the intimate mixture of these materials to vitrification, and by grinding the product of the calcining kiln, the so-called clinker, into fine powder. This product corresponds practically to Portland cement, as defined by the authorities, and is fully entitled to bear the name.

Apart from any considerations as based upon composition or method of manufacture, the results of tests prove that cement made in this manner is fully equal to any Portland cement made. Tests made in the Imperial Laboratory in Vienna show that a concrete made of one part of slag Portland cement and three parts of sand and broken limestone had a resistance to compression of 4,948 pounds per square inch; while tests on the emery wheel showed a hardness equal to granite.

It has been found that a moderate addition of granulated blast furnace slag improves the quality of this Portland cement, besides reducing the cost of production, which may be explained by the fact that the free lime in the clinker enters into combination with it. Non-granulated slag cannot be used for this purpose, as it does not contain any free silica ready for combination with the lime, as is the case with the granulated slag, where it is formed during the process of granulation. This may be seen from the fact that the non-granulated

slag remains almost intact when treated with quicklime and water, whilst granulated slag readily combines with the lime.

Portland slag cement possesses the valuable property of increasing in hardness the older it gets. Thus, a mortar composed of one part of slag Portland cement and three parts of sand showed a tensile resistance of 350 pounds per square inch after 28 days, increasing to 686 pounds after 365 days. Comparative tests of Portland slag cement with ordinary slag cement showed nearly double the strength in favor of the former.

M. de Schwarz discusses the processes of von Forell and of Passow, the former consisting of the burning of the mixed slag and limestone in a rotary kiln and the addition of a proportion of granulated slag before grinding, while the latter uses air-granulated slag, ground without any subsequent mixture. The Passow process is suited only for very basic slags, while that of von Forell relates only to modifications of certain details, and is practically the process already described of mixing the slag and limestone before burning and grinding.

The whole paper is most interesting as serving to differentiate in the public mind the relation between common slag cement and that made in accordance with correct chemical principles. There has been much opposition on the part of dealers in cements as regards the right of makers of slag cements to use the term "Portland" cement in connection with their products; and so far as the ordinary slag cement, made without subsequent vitrification with the added lime, is concerned, this position is undoubtedly correct. When, however, the unburned limestone is added to the slag, and the mixture is carefully burned and ground, the process is practically identical with that used in the standard methods of the manufacture of Portland cement, and both by reason of its chemical composition and its physical properties the product is fully entitled to bear the name "Portland" cement, as analyses and tests have demonstrated.

RADIO-ACTIVE SUBSTANCES.

AN HYPOTHESIS AS TO THE SOURCE OF THE ENERGY LIBERATED BY RADIUM AND SIMILAR SUBSTANCES.

Prof. J. J. Thomson—Nature.

THE remarkable discoveries in the field of radio-activity which have been made by M. Becquerel, M. and Mme. Curie, and other investigators, have been followed in these columns, and very recently the phenomenon of the continuous emission of heat by salts of radium was commented upon. This phenomenon, apparently contradictory to our ideas of physical laws, has given rise to a variety of hypotheses as to the nature of the processes by which radium and similar substances are able to give out energy for an indefinite period.

It has been suggested that radium may draw upon the kinetic energy due to the molecular motions of air. The radium atoms may be so constituted that they can abstract kinetic energy from the rapidly moving air molecules, and at the same time not give up any of their own energy to the slowly moving molecules. But it is hard to see how this hypothesis can explain the action of radium in melting a block of ice. The radium is placed in a closed cavity in the block of ice, and, according to the above hypothesis, the combined energy of the radium and the air in the cavity will not change, for any energy gained by the radium must be lost by the air. The ice, however, is melted, and the radium is clearly able to supply the energy needed for this action.

It has been also suggested that the air is traversed by a very penetrating kind of Becquerel radiation, and that it is the absorption of this radiation that furnishes the energy to the radium. Experiments have shown that the ionisation of a gas inside a closed vessel is diminished by immersing the vessel in water, suggesting that at least part of the ionisation of the gas is caused by a radiation which can penetrate the walls of the vessel, but which is stopped by the water. In order, however, that radium should possess the heating effects which have been observed, its absorption of this radiation must be far greater than that ob-

served in the case of experiments with other metals.

It is possible that this may be the case, but a more reasonable hypothesis has been offered by Prof. J. J. Thomson, in a recent issue of *Nature*. He thinks "that the absence of change in radium has been assumed without sufficient justification; all that the experiments warrant us in concluding is that the rate of change is not sufficiently rapid to be appreciable in a few months. There is, on the other hand, very strong evidence that the substances actually engaged in emitting these radiations can only keep up the process for a short time; then they die out, and the subsequent radiation is due to a different set of radiators. Take, for example, Becquerel's experiment when he precipitated barium from a radio-active solution containing uranium, and found that the radio-activity was transferred to the precipitate, the solution not being radio-active; after a time, however, the radio-active precipitate lost its radio-activity, while the solution of uranium regained its original vigor. The same thing is very strikingly shown by the remarkable and suggestive experiments made by Rutherford and Soddy on thorium; they separated ordinary radio-active thoria into two parts, transferring practically all the radio-activity to a body called by them thorium X, the mass of which was infinitesimal in comparison with that of the original thoria; the thorium X thus separated lost in a few days its radio-activity, while the original thoria in the same time again became radio-active. This seems as clear a proof as we could wish for that the radio-activity of a given set of molecules is not permanent. The same want of permanence is shown by the radio-active emanations from thorium and radium, and by the induced radio-activity exhibited by bodies which have been negatively electrified and exposed to these emanations or to the open air; in all these cases the radio-activity ceases after a few days. I have recently found that the water from deep wells in Cambridge contains a radio-active gas, and that this gas, after being liberated from the water, gradually loses its radio-activity; the radio-activity of polonium, too, is known not to be permanent.

"The view that seems to me to be suggested by these results is that the atom of radium is not stable under all conditions, and that among the large number of atoms contained in any specimen of radium, there are a few which are in the condition in which stability ceases, and which pass into some other configuration, giving out as they do so a large quantity of energy. I may, perhaps, make my meaning clearer by considering a hypothetical case. Suppose that the atoms of a gas X become unstable when they possess an amount of kinetic energy 100 times, say, the average kinetic energy of the atoms at the temperature of the room. There would, according to the Maxwell-Boltzmann law of distribution, always be a few atoms in the gas possessing this amount of kinetic energy; these would by hypothesis break up; if in doing so they gave out a large amount of energy in the form of Becquerel radiation, the gas would be radio-active, and would continue to be so until all its atoms had passed through the phase in which they possessed enough energy to make them unstable; if this energy were 100 times the average energy it would probably take hundreds of thousands of years before the radio-activity of the gas was sensibly diminished. Now, in the case of radium, just as in the gas, the atoms are not all in identical physical circumstances, and if there is any law of distribution like the Maxwell-Boltzmann law, there will, on the above hypothesis, be a very slow transformation of the atoms accompanied by a liberation of energy. In the hypothetical case we have taken the possession of a certain amount of kinetic energy as the criterion for instability; the argument will apply if any other test is taken.

"It may be objected to this explanation that if the rate at which the atoms are being transformed is very slow, the energy liberated by the transformation of a given number of atoms must be very much greater than that set free when the same number of atoms are concerned in any known chemical combination. It must be remembered, however, that the changes contemplated on this hypothesis are of a different kind from those occurring in ordinary chemical combination. The changes we are considering are changes in the configuration of the atom, and it is possible that changes of this kind may be accompanied by the liberation of very large quantities of energy. Thus, taking the atomic weight of radium as 225, if the mass

of the atom of radium were due to the presence in it of a large number of corpuscles, each carrying the charge of 3.4×10^{-10} electrostatic units of negative electricity, and if this charge of negative electricity were associated with an equal charge of positive, so as to make the atom electrically neutral, then if these positive and negative charges were separated by a distance of 10^{-8} cm., the intrinsic energy possessed by the atom would be so great that a diminution of it by 1 per cent. would be able to maintain the radiation from radium as measured by Curie for 30,000 years.

"Another point to be noted is that the radiation from a concentrated mass of radium may possibly be very much greater than that from the same mass when disseminated through a large volume of pitch blende; for it is possible that the radiation from one atom may tend to put the surrounding atoms in the unstable state; if this were so, more atoms would in a given time pass from the one state to the other if they were placed so as to receive the radiation from their neighbors than if they were disseminated through a matrix which shielded each radium atom from the radiation given out by its neighbors."

These considerations are highly interesting, not only as an explanation of the behavior of radium, but as showing that vast amounts of energy may be due to the inherent motions and configurations of the molecules and atoms of substances, energy which at present is beyond our reach, but which we may yet learn how to control and use.

THE DECAY OF METALS.

A STUDY OF THE NATURE AND CAUSES OF THE DETERIORATION OF METALS IN ENGINEERING STRUCTURES.

Institution of Civil Engineers.

PROBABLY no one department of the study of materials of construction has received more attention of late than that of their strength or resistance to the various stresses occurring in engineering structures. Testing machines of great ingenuity and large cost have been made, and delicate recording devices produced to be used in connection with scientific investigations, while a great international society has been formed to unify methods of using such apparatus, and to effect interchange of knowledge upon the subject. In addition to all this scientific study of the strength of materials, the practical employment of testing machines by the engineer, the manufacturer, and the contractor has continually increased, so that there is no doubt that more is known at the present time about the strength of the materials entering into a given structure than ever before.

There is an important side to the question of the strength of materials, however, which has not received the attention which it has deserved, namely, the permanence of the resistance with the lapse of time. It is most desirable to know the resistance of the original structure, but it is equally important to know the nature and extent of its deterioration. We are all familiar with the phenomena of the decay of wood and of other organic substances, but the nature of the decay of metals is less frequently considered. It is this question of the deterioration of metals which forms the subject of a paper presented before the Institution of Civil Engineers by Messrs. J. T. Milton and W. J. Larke, and the value of the information and the importance of the conclusions renders an abstract desirable.

It is generally understood that iron and steel are liable to deterioration by corrosion or rusting, and hence various methods of protection of such metallic surfaces have been employed. When, however, extreme durability is desired, copper, brass, gun-metal, and other alloys have been chosen, but even these metals have been found to corrode or decay under seemingly obscure conditions.

Among the examples discussed in the paper may be enumerated: the pitting of the tubes of marine surface condensers; the decay of brass bolts in composite vessels; the decay of the brazing metal in copper steam pipes; the deterioration, as

distinguished from oxidation, of cast iron used for parts of marine engines; and the decay of some propellers made of special bronzes when fitted to copper-bottomed vessels.

One of the most important questions is that relating to the deterioration of the tubes of surface condensers. These have been made of copper-zinc alloys, with especial view to durability, but in some cases they are found eaten into holes, and in other instances to suffer a general decay while retaining their original form. This deterioration, in the case of copper-zinc alloys, appears to be due to the loss of zinc, probably due to galvanic action, the remaining metal becoming a spongy mass of copper. This action takes place, not only when the metal is exposed to heat and moisture, but also under less obvious circumstances. Thus hard drawn spring-wire of brass, when hung up in coils in a storeroom, has been found after the lapse of time to become almost rotten and altogether useless for springs, the zinc having segregated from the copper to a large extent.

Such action naturally lends itself to study by the methods of metallography, and Professor Arnold has shown that some copper-zinc alloys appear to possess a duplex structure, both constituents being definite chemical compounds of copper and zinc, but one richer in copper than the other, these having a galvanic action upon each other whereby the zinc is separated. In the case of the deterioration of cast iron a similar action occurs, the iron gradually disappearing and the graphitic carbon remaining.

When the metal is of homogeneous composition the causes for decay are less obvious, but they may frequently be found in local impurities. Thus, condenser tubes, supposed to consist of an alloy of copper and zinc only, or of copper, zinc and tin, really contain other elements, commercial copper and zinc rarely being pure. If the impurities are uniformly distributed through the mass of the alloy it may still be homogeneous, but the tendency to segregation will produce a lack of uniformity, causing local galvanic action and consequent pitting.

If such segregation occurs during the solidification of the alloy in casting, the impure portions are subsequently drawn out into elongations in conection with the manufacture of the tubes, thus preparing the way for seamy corrosion. A number of experiments have been made to investigate such action, the conclusions being that the presence of lead increases the liability to corrosion, while the addition of a small proportion of tin gives material protection, especially against the action of sea water.

The general conclusions given in the paper, as the result of numerous experimental investigations are, in abstract:

Decay is more frequent in metals which have a duplex or complex structure than in those which are comparatively homogeneous. It is due to a slower action than that causing ordinary corrosion; a part only of the constituents being attacked, while in corrosion all the material is affected. Both decay and corrosion may result from chemical action alone, or from chemical and electrolytic action combined. Pitting, or intense local corrosion, is often due to local segregation of impurities in the metal, but it may also be caused by local irregularities of structure, producing local irregularities in the distribution of galvanic currents.

In the case of brass exposed to the action of sea water, tin is distinctly preservative, while lead and iron are both injurious, rendering the brass more readily corrodible, so that the percentage of the latter metals should be kept as low as possible. Smoothness of surface also reduces the liability to corrosion, and hence it is desirable that the cylinders from which tubing is drawn should be smoothly bored inside.

Experiments in electrolysis show that very minute currents may produce very severe corrosion and decay. All electric cables or other sources of galvanic action should therefore be most carefully insulated, or where such insulation is not possible, the currents should be neutralized by the application of zinc plates in the circuit so arranged that they are negative to both of the other metals.

While these investigations relate mainly to the decay of copper-zinc alloys, and those used principally for tubes exposed to the action of sea water, yet the lesson may be extended broadly to other materials and various applications. It is not sufficient to know that a metal originally possesses a

certain general composition and a fairly well determined strength. The effects of the presence of impurities must be studied, as well as the action of elements to which it may be exposed. Deterioration should be considered, and, if possible, prevented; or, if prevention is impracticable, this fact should be taken into account in the determination of dimensions, and in the limitations to be imposed in actual service.

IMPROVEMENTS IN RAILWAY SHOP ORGANIZATION.

BETTER TOOLS AND LETTER PRACTICE BRING BETTER WORKMEN AND AN ADVANCED MORAL TONE.

Charles H. Fitch—The Railway Master Mechanic.

A SERIES of papers on Roailroad Shop Tools, by Mr. Charles H. Fitch, appearing in the *Railway Master Mechanic,* present under a somewhat specialized title certain suggestions which are highly interesting and widely applicable to the conditions to be observed throughout the mechanical industries generally. "We cannot," says Mr. Fitch, "separate from shop tools those whose brains they empower and whose hands they sometimes supplant—namely, the men. Nor can we fail to consider the inter-relations of shop tools, their encroachments upon one another, and the whole combination of appliances, moving or static, which enables us to consider a shop equipment as one comprehensive machine operated by an organization of men."

"In 1881 I was at the Dickson Locomotive Works, looking for data and improvements in shop tools. A foreman there said: 'In 1870 we had fewer tools and about three times as many men in the shops to do the same work.' Here we are in 1903. Vastly more and better tools, more shops, better men. I venture to state my belief that if we could measure off an average man from the shops of 1870 against the average man of the shops of to-day we would find the latter heavier, larger and better built and nourished in body, and with a distinctly heavier and better organized brain."

It is not yet quite the golden age. "The fact remains," says Mr. Fitch, "that we have a great deal that is coarse, crass and unintelligent to deal with, and that there remain unfair spots in administration as there are hard spots that interfere with the turning of work in the wheel lathe. But a man who has been going about machine shops for thirty years knows that there are facts of moral atmosphere as well as machine improvement, that present-day shops are head and shoulders over the old shops. When I first came west the first shop I struck (not a railroad shop) was one babel of profanity from morning till night; intemperance and scamping tricks were usual, and the prevailing idea seemed to be to curse the work through somehow. It was a big shop, too. I do not need to go to that shop to-day to testify that no such conditions prevail. I know that it is clean-mouthed, that the curses have given place to quiet and effective thought. I know that the best man is not the biggest drinker, kept because brains were so scarce that even an intoxicated brain could not be let go. I know that temperance is the invariable rule and that there is more gentleness and higher intelligence in every rank of work from manager to helper. I know these things without going to verify them because I know the old conditions would not be tolerated in any American shop. I know that this shop, now much bigger than before, is 'right down in front' with modern shop tools and system, and is itself one of the largest producers of labor-saving machine tools for railroad shops. The rest follows. Not more surely does freedom (under constitutional law) follow the flag, than do good morals follow improvements in shop tools.

"The importance of this can be realized by looking back to peon labor, the labor of the brutal man requiring the urgency and restraint of force to maintain the simplest continuous work. Fine tools are not possible with such men, and while harsh measures can control them their work is low grade. There is something like tempering steel in men, a critical point between force and intelligence. That critical point was once thought to be the limit of work, but

we have found that we can go beyond it securely and produce better results. The critical point with men comes when they are tempered to such fiber that they are too shrewd to be safely governed by force and too stupid to be allowed to govern themselves by intelligence. In the future government by intelligence will prevail and improved shop tools will strengthen it."

So much for the moral and sociological expression of the change; its physical—or, if you please, its industrial—result is epitomized in the fact cited by Mr. Fitch that "it takes but a few more men a year, on the average, to build the modern locomotive than the ancient one." But a few more human labor hours in the 110-ton decapod than in the 7-ton "Old Ironsides." And because of that, thousands of locomotives built and tens of thousands used in 1903 for every one in 1832—hundreds of thousands of men profitably and productively employed now, where there was scarcely room for scores then. And yet "organized labor" too often seems able to see only the reduction of labor hours on the single job, and to have no vision of the vast demand for vastly more labor, and higher and happier labor, which every such reduction brings. Their perception of it lies at the end of a long era of education, which is but begun. That they have as yet so little understanding is often cause of distress, but never reason for despair.

THE VIAUR VIADUCT.

A DESCRIPTION OF A GREAT STEEL RAILWAY ARCH OVER A RIVER IN THE SOUTHERN PART OF FRANCE.

Le Génie Civil—Bulletin of the International Railway Congress.

A FEW months ago, the Midi Railway opened a line from Carmaux to Rodez, in the southern part of France, which has been under consideration since 1876, and which is of great commercial importance, as it gives an outlet toward the center of the country for the extensive mineral wealth of the Carmaux district. The construction is of a difficult character, as the line traverses the high Rouergue plateau, and crosses several deep ravines, the most important of the latter being the valley through which the Viaur river flows. This valley was the chief obstacle to be overcome, and it was necessary to build a great viaduct to cross it.

After several tentative plans for this structure had been drawn and discussed, a competition was instituted, as a result of which seven designs were submitted by some of the leading bridge companies of France. Several of these designs were for viaducts consisting of trusses supported on either high metallic towers or masonry piers. Another design showed a rigid steel arch, hinged at the center, and serving as a support for the middle trusses of the viaduct, the other trusses being carried on metallic towers. Still another plan called for two cantilevers, connected by a short truss at the center of the viaduct.

The design which was finally adopted, however, was a radical departure from any of the others, and has, in fact, set a new fashion in arched bridges. It may be described, in short, as a cantilever arch. Each half of the central span is balanced by another half arch on the approach side, the extremities of these side arches not resting on the masonry abutments, but being connected with them by means of short lattice trusses. The central arch is pivoted at the abutments and hinged at the key, and the side arches are hinged at their connection with the end trusses, which take up any vertical movement at that point due to temperature variations or moving loads.

This design was submitted by the Société de Construction des Batignoles, and is due to M. Bodin, its consulting engineer, who is also professor at the Ecole Centrale des Arts et Manufactures and president of the Société des Ingénieurs Civils de France, and to M. Godfernaux, the chief engineer of the company. Descriptions of the completed viaduct have appeared recently in the *Génie Civil*, written by M. Henry Martin, and in the *Bulletin of the International Railway Congress*, from which our account is taken.

The original design was for a central span of 250 meters (820 feet) but this was modified, owing to a change in the Government

regulations and to the advice of the Government engineer, so that the design, as finally adopted, provided for a central arch, of 220 meters (722 feet) with a rise of 53.73 meters (176 feet). As before stated, this central span is hinged at the key, and each of the half arches of which it consists, which rest on pivots at the masonry piers, is balanced on the other side of these piers by another half arch, whose length is 69.6 meters (228 feet). The outer extremity of this cantilever is connected to the masonry abutment by an independent steel girder of an open lattice type, 25.4 meters (83 feet) long, which forms a junction between the fixed part and the movable part of the structure. The horizontal distance from the masonry pier to the abutment at either end is therefore 95 meters (312 feet) and the total length of the metallic part of the structure is 410 meters (1,345 feet). The masonry portion of the viaduct is 21 meters (69 feet) at one end and 29 meters (95 feet) at the other, so that the length over all of the entire structure is 460 meters (1,510 feet). The height of the rails above the bed of the stream is 116 meters (381 feet).

The viaduct carries a single track running on top of the straight upper booms The lower booms are polygonal, with straight members of varying lengths between the piers and the center. The upper and lower booms are connected together by diagonals and verticals, with no redundant members. In order to assure complete stability, even in the highest winds, the two ribs which compose each half of the arch have an inclination of 1 in 4, the distance between their centers at the top just over the masonry piers being 5.89 meters (19 feet) and the bottom, 33.39 meters (110 feet) which is, of course, the distance between the pivots on the piers. These two main ribs are rigidly connected together, and are stiffened both at the verticals and at some of the diagonals by a system of wind-bracing consisting of cross girders and cross bracing, and the cross girders carrying the rails also act as stiffners. The principal diagonal and vertical members are latticed columns, enlarged at the middle in order to resist compressive stresses better.

The floor is formed with cross-girders attached to the verticals of the main girders. The cross girders are connected by longitudinal beams and on these rest Z beams, laid transversely and riveted to the main and secondary longitudinals. The flooring is also stiffened by three rows of longitudinal Z beams placed underneath and riveted to each of the transverse Z beams. The rails are double-headed and rest in chairs placed on the stringers which are carried by the transverse Z beams. There is a footpath on either side of the track, consisting of corrugated iron plates 80 centimeters (2 feet, 7½ inches) wide. Outside the footpaths are steel railings 1.8 meters (6 feet) high, and strong enough to hold locomotives and cars in case of derailment. The railing is formed of main and secondary posts and of several horizontal bars.

The key pin is a forged steel cylinder 95 centimeters (3 feet, 1 inch) long, and turned to a diameter of 20 centimeters (7⅞ inches) on which bear two cast-steel saddles fixed to the ends of the half arches, the diameter of the saddles being 20.5 centimeters (8 1-16 inches). Both ends of the pin pass through eyes in the ends of bars which are riveted to the extremities of the half arches, in order to hold the pin in case the pressure at the center is abnormally reduced. There is very little probability of this occurring, as the design gives a minimum thrust on the pin of 151 tons.

The material used for the structure is mild steel, except that the end trusses, the flooring, the rivets and some other parts are of iron. The total weight of the metallic structure is about 3,500 long tons, equivalent to about 8,400 kilograms per running meter (5,640 pounds per running foot). The total cost, including that of the masonry, is estimated at 2,700,000 francs.

The side arches and the end trusses were erected on timber scaffolding. The cantilever arches were then loaded and anchored and the erection of the two halves of the central arch was carried on with travelers, without any falsework. Near the site of the bridge there was a yard where the parts of the structure were made up into the largest pieces that could be handled by the traveler, and in some cases, important joints were riveted up experimentally.

The final design was approved of in April, 1896, the erection of the metallic structure

was begun about the middle of 1898, and the inauguration of the viaduct took place in October, 1902.

When finished, the bridge was subjected to severe tests, with locomotives weighing 73 tons, tenders weighing 26.4 tons, and cars weighing 22 tons apiece. With two locomotives placed head to head at the center of the arch, there was a deflection of only 41 millimeters, which was less than that calculated. Trains with two locomotives and twenty cars, representing a total weight of 639 tons, were run over the structure at speeds of 20 and 40 kilometers (12½ and 25 miles) per hour, and caused only slight deflections at the key and at the ends of the cantilevers.

The span of the great central arch, 722 feet, is exceeded by only one in all the world, the Niagara-Clifton arch, which is 840 feet. But the latter is a comparatively light structure, built for highway and electric tramway purposes, and it has a total weight of only about 2,000 tons, as compared with the 3,500 tons of the Viaur viaduct. The total length of the Niagara-Clifton structure, including the approach spans, is 1,240 feet, and its height above the Niagara river is 185 feet, while the corresponding dimensions for the Viaur viaduct are 1,345 feet and about 380 feet. Among the other great steel arches of the world may be mentioned the Niagara railway arch, with a central span of 550 feet, the Müngsten viaduct in Germany, 525 feet, and the Garabit viaduct in France, 541 feet. In spite of its colossal dimensions, the Viaur viaduct presents a singularly light and graceful appearance, and adds to the beauty of the landscape in which it is set.

THE VALTELLINA RAILWAY.

AN ELECTRIC PASSENGER AND FREIGHT RAILROAD IN NORTHERN ITALY, OPERATED ON THE GANZ THREE-PHASE SYSTEM.

Elektrotechnische Zeitschrift—The Electrician—Zeitschrift des Oesterreichischen Ingenieur- und Architekten-Vereines.

EVER since the Valtellina electric railway was first planned, it has excited the interest of electric engineers in all parts of the world, as it is the principal application, so far made, of high-tension three-phase currents to traction work. The Ganz Company, of Budapest, whose system was adopted for this road, have been experimenting with three-phase current on railways for a number of years, and before the road was taken over by the owners thorough tests, extending over a considerable period, were made. These proved satisfactory, and the road has now been in successful operation for several months, so that an estimate of the value of the system can be made. It may, therefore, be of interest to review some accounts of this railway and its equipment, which have appeared in recent issues of the *Elektrotechnische Zeitschrift* and the *Zeitschrift des Oesterreichischen Ingenieur- und Architekten-Vereines*, by Herr Eugen Cserháti, one of the officers of Ganz & Co., and in *The Electrician*.

The Valtellina road runs from Lecco, near the southern end of Lake Como, along the eastern border of the lake to Colico, a distance of about 39 kilometres. Here it branches, one line going north about 26½ kilometers to Chiavenna, and another east, up the valley of the Adda, about 41 kilometers, to Sondrio, the total length of the road being a little over 106 kilometers, or 66 miles. It was formerly a regular steam railway, doing a large passenger and freight business, the passenger traffic being particularly heavy in the summer months, as this road is on the line of travel for tourists between the Engadine and the Tyrol and Lombardy. There is also considerable local traffic, both passenger and freight, manufactures of silk and cotton and agricultural products making up the bulk of the latter. It will thus be seen that the service required is that of a first-class railway.

The line is owned by the Italian Government and operated by the Adriatic Company, but the electrification of the road was undertaken by a special company, which was formed to develop the possibilities of electric traction on Italian railways.

The power is derived from the Adda river. A movable dam was built, and part

of the stream diverted through a 4.8-kilometer canal to the power station at Morbegno. The effective head varies from 90 to 100 feet, and the minimum horse power available is 7,500. In the power house are three 2,000-horse-power Francis reaction turbines, with horizontal axes, directly connected to three-phase generators.

The generators furnish current at a voltage of 20,000, with a frequency of 15 periods per second. Their normal capacity, with a power factor of 0.7, is 1,050 kilowatts, but they can be heavily overloaded without excessive heating, and can even stand a short circuit for two minutes, without injury. With constant speed, the voltage varies 15 per cent. for a change from no load to one of 1,500 horse power, and when the full load is suddenly taken off, the rise in voltage is not more than 10 per cent. The weight of each generator is 69,300 kilograms, the rotating parts alone weighing 43,800 kilograms.

After leaving the switchboard, which is very carefully arranged to secure complete safety for the operatives, the high-tension line goes first to the railway station at Morbegno. Here it divides, one branch, consisting of three bare copper conductors, each 7 millimeters in diameter, running about 20 kilometers towards Sondrio, and the other branch, with three 8-millimeter conductors, going to Colico. At this point the line branches again, one part going toward Lecco and the other toward Chiavenna. The conductors are carried on red larch poles, with a minimum diameter of 0.3 meter at the butt and 0.25 meter at the top. The primary wires are placed one above the other, at intervals of 60 centimeters, on porcelain insulators having four petticoats, which are fixed to iron brackets on the outer side of the poles. For the most part, the primary conductors are carried on the same poles which support the trolley wires, but at tunnels they run outside on independent poles.

There are nine sub-stations, eight of which have each a 300-kilowatt, three-phase, static transformer; and one, at Abbadia, has two such transformers. These stations have two rooms; in the outer one are the conductors and switches and the ventilator for the transformer, and in the inner are the transformer itself and the lightning arresters for the primary and secondary circuits. These transformers reduce the potential to 3,000 volts, at which pressure it is used directly on the trolley wires and in the motors. As the transformers are subjected to a very fluctuating load, they are designed so that they will carry five times their normal load without injury and without excessive drop in voltage.

At present the passenger traffic of the Valtellina road is carried on by motor cars, and the freight hauling is done by locomotives, but it is planned to operate the heavy and high-speed passenger trains also by locomotives which shall be able to haul 250-ton trains up one per cent. grades at speeds of 60 to 70 kilometers an hour, and 400-ton trains at 35 kilometers. The motor cars now in operation weigh 53 tons and can haul from 5 to 7 trailers, with a total weight of 150 tons, up one per cent. grades with a speed of 65 kilometers per hour. There are ten such motor cars, five of them luxuriously fitted for first-class traffic, and five composite passenger cars, for different classes.

The car body rests on two trucks, each of which carries two polyphase motors. One motor on each truck is wound for the working voltage of 3,000, while the other, or low-tension, motor is designed for 300 volts. The latter is an auxiliary motor, which is used only at starting, when ascending heavy grades, and when, on descending grades, energy is being returned to the line. At such times, the two motors are connected in "cascade," as the arrangement is termed, the stator windings of the principal motor carrying the high-voltage current, while its rotor coils are connected to the stator circuit of the auxiliary motor. The rotor of the latter is in circuit with the starting resistance, which consists of a liquid rheostat, in which the resistance is gradually reduced by raising the liquid, in which contact plates are held. The liquid is raised by means of compressed air, and when the plates are fully immersed, the rheostat is short-circuited. At this point, with no resistance in circuit, the motors are running in "cascade" synchronism, which is at half speed. To increase the speed, the auxiliary motor is cut out, and the rheostat connected with the principal motor and gradually short circuited until the principal motor is running without any resistance, when it will be at full synchronism.

There are three definite positions of the controller: the first, when both motors are cut out; the second, when the motors are connected in cascade and the rheostat is in circuit with the auxiliary motor; the third, when the auxiliary motor is cut out, and the rheostat is in circuit with the principal motor. At starting, the controller handle is placed at one of these points, and a stop-cock opened which admits the compressed air to the liquid rheostat. To go from half speed to full speed, the stop-cock must first be closed, then the controller handle is moved to the third position and the air again admitted to the rheostat. The speed at which the water rises in the rheostat can be closely regulated.

An air compressor, driven by an independent motor, supplies the air needed for the operations already described, as well as for the Westinghouse brakes and the whistle. A transformer, with a 100-volt secondary circuit, furnishes the current for the air-compressor motor, as well as for heating and lighting. There is also another lighting circuit on each car, supplied with current from accumulators, in order to provide for any interruption to the main line current.

The two electric locomotives already in service weigh 46 tons apiece, and have four axles, each provided with a 150-horse-power high-tension motor. The cascade arrangement is not used here, and the only synchronous speed is 30 kilometers per hour, which is all that is necessary for freight service.

There is an elaborate system of switching and safety apparatus in the stations, on the line, and on the rolling stock, and the road has been operated without accident since it was opened. In one period of a half-month the number of ton-kilometers was 3,293,254 and the total energy consumed, including all losses, measured at the switchboard of the generating station, was 163,470 kilowatt hours, giving an average of 49.7 watt hours per ton-kilometer.

When steam was the motive power, the number of trains daily was 34, and the train-kilometers run were 898. With electric operation, the corresponding figures are 46 and 1,668. This large increase of traffic shows that the electrification of the road has met with the favor of the traveling public.

CANADA'S MINERAL INDUSTRY.

THE MINING AND METALLURGICAL INDUSTRIES OF CANADA AND NEWFOUNDLAND, AND THEIR FUTURE DEVELOPMENT.

The Canadian Mining Review.

ALTHOUGH Canada is still far behind its great neighbor on the south in material development, it possesses vast natural resources, both agricultural and mineral, which make it potentially one of the richest countries in the world. Its far-reaching forests, its illimitable and fertile prairies, and its immense mineral deposits are sources of wealth which are as yet merely touched, but which will undoubtedly be greatly developed in the future, and will offer large opportunities for a population many times greater than that now within the borders of the Dominion.

In fact, this industrial expansion in many directions has already begun, and two or three great new railway lines are projected which will open up large territories which have hitherto hardly been explored. The mineral production of Canada grows apace, and some figures and comments concerning it, which have appeared in *The Canadian Mining Review*, possess more than a local interest.

In an article by Mr. George Johnson, the Dominion statistician, on "Mineral Production, Canada and the United States," it is stated that in 1901 the total value of the mineral products of Canada, taking round figures only, was $66,000,000, made up of $42,000,000 of metallic and $24,000,000 of non-metallic materials. Compared with the total of the United States for the same period, $1,092,000,000, this does not seem large, but taking the relative populations into account, Canada produced $12.42 per capita and the United States $14.12 per capita, a difference of only $1.70 per head. Seeing that Canada was $6 per head behind the "States" in 1891, this method of comparison shows the Dominion in a much more favorable light.

The metallic products of Canada include antimony, copper, gold, pig iron, lead, mercury, nickel, platinum, silver and zinc. In 1891, the metal output of the United States was 55 times as great as that of Canada, but in 1901 it was only 12½ times as great, and this improvement in Canada's relative position has been made in spite of the very large absolute increase in the figures for the United States. The principal part of the gain for Canada has been in gold, the production of which increased from $930,000 in 1891 to $24,000,000 in 1901. The Klondike region, of course, has contributed largely to this increase. The production of iron and steel has also grown greatly in the past ten years, with good prospects of a still brighter future. In the production of nickel Canada surpasses not only the United States, but all other countries. The total nickel product of the world for 1901 was $7,750,000, of which Canada's contribution was $4,600,000.

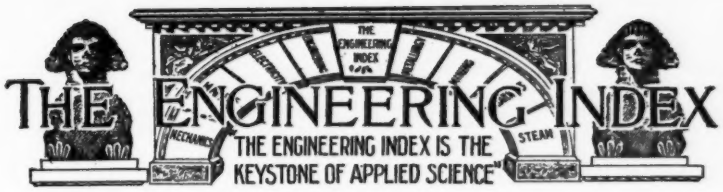
Canada's non-metallic mineral products include coal, petroleum, building materials, abrasives, chemicals, pigments, and other miscellaneous materials. Among these may be mentioned asbestos, of which 40,000 tons, valued at $1,260,000, were produced in 1901.

Newfoundland, in the popular mind, is generally thought of as a land of fogs, whose population ekes out a precarious livelihood by fishing. But as a matter of fact, it is a country whose natural resources, while still largely latent, possess great possibilities of development. The total value of its mineral products for 1902 amounted to over $1,200,000, according to figures given in an article on "Mining in Newfoundland," by Mr. J. P. Howley, and taken from his annual report to the Minister of Agriculture and Mines. Iron ore was the most valuable product, and copper ore, pyrites, slate, brick, paving stone, granite and other materials helped to swell the total. Boring operations for petroleum have resulted favorably, and the discovery of free gold has given a stimulus to the search for the precious metal, resulting in the finding of several rich specimens. Two gold quartz mines are already in operation.

But in spite of what has already been done in developing Canada's mineral resources, far more remains to be accomplished. This is well brought out in an article by Mr. Bernard MacDonald, on the "Mining Possibilities of the Canadian Rockies." By the "Rockies" is here understood all the mountainous region lying between the great central plain of the North American continent and the Pacific Ocean. It is stated that the Mexican "Rockies," which have an axial length of about 1,700 miles, have produced an average of $3,143,000 of the precious metals per mile, and that the United States "Rockies," 1,300 miles in length, have produced $3,462,000 per mile on the average, while the 1,600 miles of the Canadian "Rockies" have so far produced only an average of $104,000 per mile. The geological features of the Rocky Mountains in Canada are very similar to those of the parts of the chain in the United States and Mexico, and it is but reasonable to suppose therefore that the Canadian "Rockies" may yet produce as much of the precious metals as the western parts of the "States" and Mexico. One reason for the backwardness of Canada in this respect may be found in her climatic conditions, but these are not insuperable, as has been strikingly shown by the successful working of the Klondike placers. And if mineral veins are discovered, even in Arctic regions, they can be exploited underground with comparatively little interference by the weather, however severe.

In order to develop the latent possibilities of the Canadian "Rockies," Mr. MacDonald proposes that comprehensive, systematic prospecting should be undertaken by a large corporation, or, better still, by the Dominion Government itself. Any mineral deposits discovered by these prospecting parties would be located for the benefit of the corporation which financed them, with some claims reserved for the members of the party. If the Government undertook the work, then the members of the prospecting party which made a discovery would have the privilege of locating a couple of claims apiece, while all the rest of the territory would be thrown open to the general public.

By means of such systematic exploration on a large scale, results would be much more quickly and certainly arrived at, and the whole country would be greatly benefited by the largely increased production of the precious metals thus discovered.



The following pages form a DESCRIPTIVE index to the important articles of permanent value published currently in about two hundred of the leading engineering journals of the world—in English, French, German, Dutch, Italian, and Spanish, together with the published transactions of important engineering societies in the principal countries. It will be observed that each index note gives the following essential information about every article.

(1) The full title,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published.

We supply the articles themselves, if desired.

The Index is conveniently classified into the larger divisions of engineering science, to the end that the busy engineer and works manager may quickly turn to what concerns himself and his special branches of work. By this means it is possible within a few minutes' time each month to learn promptly of every important article, published anywhere in the world, upon the subjects claiming one's special interest.

The full text of any article referred to in the Index, together with all illustrations, can usually be supplied by us. See the "Explanatory Note" at the end, where also the full titles of the journals indexed are given.

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CIVIL ENGINEERING

BRIDGES.

Bridge Pavement.

Steel Underflooring and Wood Block Pavement for the Roadways of the Williamsburg Bridge. Gives sections showing construction, with extracts from specifications in regard to treatment for the prevention of oxidation, and requirements for materials and workmanship in paving. 1500 w. Eng News—May 21, 1903. No. 55323.

Canal Bridges.

The Weight of Iron Bridges Carrying Canals (Ueber das Eigengewicht Eiserner Brückenkanäle). Victor Waniek. The calculation of the weights of the bridges which form part of canals, and some details of construction, with tables and curves. 1 Plate. 1000 w. Oesterr Wochenschr f d Oeffent Baudienst—March 21, 1903. No. 55474 D.

East River Bridge.

Erection of the Manhattan Approaches to the Williamsburg Bridge. An outline of the design and construction of this great engineering work, with report of the progress on the viaduct approach, and related matters of interest. 1200 w. Eng Rec—May 9, 1903. No. 55146.

We supply copies of these articles. See page 638.

Europe.

Some Modern Types of Swiss and German Bridges. Gives illustrations of some artistic bridges, with descriptive notes. 900 w. Sci Am Sup—May 23, 1903. No. 55316.

Gokteik Viaduct.

The Gokteik Viaduct (Der Gokteik-Viadukt in Indien). Hr. Frahm. An illustrated account of this great steel railway viaduct in Burma, built by the Pennsylvania Steel Co. 2200 w. Stahl u Eisen—May 1, 1903. No. 55435 D.

Kew.

The King Edward VII. Bridge at Kew. Brief account of the earlier structures occupying the site of this new bridge, with many illustrations and description of the construction of this finely proportioned three-span structure. 2700 w. Engng—May 15, 1903. Serial. 1st part. No. 55369 A.

Mississippi.

The Rigolets Bridge. Brief description, with illustrations, of a structure to replace a bridge about 25 years old, on the New Orleans-Mobile line of the Louisville and Nashville. The structure is interesting on account of its length, and the use of creosoted timber piers. 300 w. R R Gaz—May 15, 1903. No. 55213.

Ornamental.

Ornamental Bridges in a Private Park. Illustrations of two bridges on a private estate in New Jersey, with description. 1300 w. Eng Rec—May 23, 1903. No. 55354.

Viaur Viaduct.

The Viaur Viaduct (Le Viaduc du Viaur sur la Ligne de Carmaux à Rodez). Henry Martin. A very well illustrated description of this great steel railway viaduct in the southern part of France, which includes an arch with a span of 220 meters. Serial. 2 parts. 2 plates. 7000 w. Génie Civil—May 2 and 9, 1903. No. 54896 each D.

The Viaur Viaduct on the Line from Carmaux to Rodez. An illustrated description of this great steel railway viaduct in the southern part of France, which includes an arch with a span of 220 metres. 3200 w. Bul International Ry Cong—April, 1903. No. 55380 E.

CANALS, RIVERS AND HARBORS.

Barge Canal.

The Lake Ontario Route for a Barge Canal. Editorial discussion of this route, giving the report of Mr. William Pierson Judson. 1700 w. Eng News—May 14, 1903. No. 55219.

British Canals.

The Canal System of Britain. H. E. P. Cottrell. Describes the present condition of the canals and navigations, briefly reviewing their history and working, and giving tabulated information of interest. Map. 5400 w. Trac & Trans—May, 1903. No. 55276 E.

Chaudiere Falls.

The Water Power Development at Chaudiere Falls, P. Q. A finely illustrated descriptive account of the plant and construction work. 6000 w. Eng News—May 7, 1903. No. 55138.

Coal Shipping.

See Mining and Metallurgy, Coal and Coke.

Corinthian Canal.

The Corinthian Canal. Gives an outline of the history of this project, describing important features and discussing why it is almost deserted by foreign craft. Ill. 1500 w. U S Cons Repts, No. 1635—May 1, 1903. No. 54989 D.

Drainage.

Red River Valley Drainage Ditches; Their Repair and Maintenance. Prof. W. R. Hoag. Discusses some things to be considered in the construction of ditches for the removal of excess of water, especially referring to this valley in Minnesota. Ill. 3500 w. Jour Assn of Engng Socs—April, 1903. No. 55-293 C.

Dredges.

The New 30-in. Hydraulic Dredge for the Port of Portland, Oregon. Two-page plate, illustrations and description of one of the most noteworthy dredges yet built, its construction and operation. 4500 w. Eng News—April 30, 1903. No. 55086.

A Small "Home-Made" Dipper Dredge or Steam Shovel. Illustrated detailed description of a power excavator very useful where it is difficult and expensive to take a dredge or steam shovel. 1000 w. Eng News—May 14, 1903. No. 55217.

The 15-Cu. Yd. Dipper Dredge for the New York Harbor Improvements. Illustrated description of the construction and operation of the largest and most powerful dipper dredge in the world. 600 w. Eng News—May 14, 1903. No. 55218.

Hudson River.

Operations of the Hudson River Water-Power Company. Charles E. Parsons. An illustrated description of the plant at Spier Falls and its construction. Power will be transmitted to surrounding cities and villages. 5500 w. Trans Am Inst of Min Engrs—Feb., 1903. No. 55383 C.

We supply copies of these articles. See page 638.

Locks.

Electrically Operated Locks on the River Seine. Daniel Bellet. Illustrates and describes the locks and barrage at Amfreville-Poses, recently built to improve the flow of the river and insure a 10 ft. 6 in. minimum depth of water between Rouen and Paris. 1900 w. Trac & Trans—May, 1903. No. 55278 E.

The Cardot Oscillating Lock (Ecluse Oscillante, Système Cardot). A. Morel. An illustrated description and a theoretical discussion of a canal lock which consists of a tank, with watertight compartments, moving on a hinge. Serial. Part 1. 2500 w. Rev Technique—May 10, 1903. No. 55424 D.

Mount Rainier.

Electric Power Plant Below Mount Rainier. Earl Mayo. Brief account of a plant under construction which will utilize a glacier flow on the Pacific coast, and deliver electric energy to the cities of Washington. 1300 w. Sci Am—May 23, 1903. No. 55311.

Panama Canal.

The Panama Canal: The Dual Versus the Single-Lake Project. Gen. Henry L. Abbot. Summarizing the objections to the high-level plans advanced by the Isthmian Canal Commission and by Mr. George S. Morison, and the superior advantages of the project of the Comité Technique for a lower summit at Lake Bohio and a second dam at Alhajuela. The article is a reply to one by Mr. Morison in The Engineering Magazine for January, 1903. 2400 w. The Engineering Magazine—June, 1903. No. 55492 B.

The Advantages of Lake Bohio at the Higher Level. George S. Morison. A brief expression of the conclusions which led the Isthmian Canal Commission to advocate plans for the Panama Canal with a high summit level, and an answer to the principal criticisms of those plans, especially as to the Bohio Dam. Ill. 900 w. The Engineering Magazine—June, 1903. No. 55493 B.

The Panama Canal (Der Panama-Kanal). W. Kaemmerer. A general review of the Panama Canal and the principal plans for its construction, with maps and illustrations. 3500 w. Zeitschr d Ver Deutscher Ing—May 9, 1903. No. 55450 D.

St. Francis River.

An Estimate of the Discharge of the St. Francis River. K. M. Cameron. A summary of the methods employed and of the results obtained by the students of McGill University in the determination of the discharge of the river by means of current meters. Ill. 2800 w. Can Soc of Civ Engrs—Adv proof—April, 1903. No. 55169 D.

CONSTRUCTION.

Coal Pocket.

Foundation for Coal Pocket at Lincoln Wharf, Boston Elevated Railway Co. Robert B. Davis. An illustrated description of the foundation or wharf under an up-to-date coal pocket. 5 plates. 3000 w. Jour Assn of Engng Socs—March, 1903. No. 55160 C.

Concrete-Steel.

A Tall Concrete-Steel Office Building. An illustrated detailed description of the Ingalls building, Cincinnati, Ohio. 3200 w. Eng Rec—May 23, 1903. No. 55353.

Concrete Structures.

A New System of Finishing Concrete Structures. Describes a method by which a fine concrete facing when roughened is made to have the appearance of stone. Ill. 1100 w. Eng News—May 21, 1903. No. 55320.

Dams.

Report on Bad Foundations Beneath the Core-Wall of the Earth Portion of the New Croton Dam. A report by Wm. R. Hill in regard to the disintegration of the limestone foundations beneath the core-wall of the earth section. Ill. 700 w. Eng News—May 14, 1903. No. 55221.

The Problem of the Great Croton Dam—New York City Water Supply. An illustrated article explaining the defects which have caused public alarm, and what has been done to remedy them. 1400 w. Sci Am—May 30, 1903. No. 55523.

The Wigwam Reservoir Masonry Dam of the Water-Works of Waterbury, Conn. R. A. Cairns. An illustrated account of the construction and the growth of the city that made the work necessary. 2400 w. Eng News—May 7, 1903 No. 55140.

Docks.

The Construction of Docks. Alexander MacLachlan. An article dealing with typical forms of modern docks and discussing details. Ill. 3300 w. Feilden's Mag—May, 1903. Serial. 1st part. No. 55376 B.

Fireproofing.

The Economics of Construction. John Lyman Faxon. The first of a series of papers urging a departure from the present system of steel framing and the adoption of solid masonry construction, and burnt clay products, claiming not only greater endurance, but less cost. 2800 w. Br Build—April, 1903. Serial. 1st part. No. 55030 D.

Foundations.

Grillage vs. Concrete Foundations. From a paper by J. C. Hain, read before

We supply copies of these articles. See page 638.

the Iowa Ry Club. The relative merits of grillage on a pile foundation and the method of surrounding the heads of piles with concrete several feet below the cut-off. 1700 w. Ry & Engng Rev—May 23, 1903. No. 55343.

Grain Elevators.

Grain Elevators. An illustrated article considering the various types, new and old, and giving some loss figures from fires. 2800 w. Ins Engng—May, 1903. No. 55303 C.

Hangers.

Points that Should be Considered in Selecting or Designing Joist and Wall Hangers. F. E. Kidder. An illustrated article giving information of interest and practical value. 3300 w. Ins Engng—May, 1903. No. 55304 C.

Intake Tunnel.

Defective Work in the Cleveland Water-Works Intake Tunnel. Describes the condition of the tunnel under Lake Erie, recently built. Ill. 1000 w. Eng Rec—May 23, 1903. No. 55357.

Medical Building.

Structural Details of the Medical Building, Cornell University. Illustrated description. 1800 w. Eng Rec—May 16, 1903. No. 55231.

Piers.

Personal Experiences in the Construction of a Landing Pier for the Ocos Railway, Guatamala, C. A. Charles List. An illustrated account of the history and construction of the pier, some of the experiences and deductions. 3000 w. Jour Assn of Engng Soc's—March, 1903. No. 55159 C.

Portable Structures.

Dismountable and Portable Structures (Un Système de Constructions Démontables). J. J. Pillet. An illustrated description of a system of construction for portable and semi-portable buildings of many kinds, for military and civil use, invented by Lieut. Col. Espitallier. 2000 w. Bull Soc d'Encour—April 30, 1903. No. 55400 G.

Reservoirs.

Estimating Soil Stripping from Water-Supply Reservoirs. Two papers and discussion at meeting of the Boston Soc. of Civ. Engrs. I. A Comparison of Three Methods of Estimating Quantities of Soil Stripping from Water-Supply Reservoirs. Frank S. Hart. II. Method of Estimating Quantities of Soil Excavation from Wachusett Reservoir. Charles A. Bowman. Ill. 14000 w. Journ Assn of Engng Soc's—April, 1903. No. 55292 C.

Roads.

Tar-Macadam Roadways in Ontario. Report of the city engineer of Hamilton, Ontario, describing the method of construction. Ill. 2500 w. U S Cons Repts, No. 1649—May 18, 1903. No. 55256 D.

Coal Tar as a Road Material. Favors its use, discussing precautions necessary and giving general information. Ill. 1700 w. Automobile—May 23, 1903. No. 55338.

Improved Maintenance of Earth Roads. Henry P. Morrison. Suggests lines of investigation tending to the betterment of country roads. 1500 w. Eng Rec—May 2, 1903. No. 55116.

Underpinning.

Difficult Supports for Underpinning. Brief description, with illustrations, of difficult underpinning made necessary by quicksand, when adjacent foundations were excavated. 1200 w. Eng Rec—May 2, 1903. No. 55115.

MATERIALS.

Asphalt.

Rock Asphalt and Asphalt Mastic. Henry Wiederhold. Gives brief review of the uses of asphalt, where found, and the quality, especially considering rock asphalt and its value as a building material. General discussion. 9200 w. Pro Engrs Club of Phila—April, 1903. No. 55163 D.

Cement.

Manufacture of Cement from Marl and Clay. Henry S. Spackman. Information concerning the marl deposits and an illustrated account of the methods used. 4800 w. Pro Engrs Club of Phila—April, 1903. No. 55161 D.

Decay of Metals.

See Mechanical Engineering, Materials.

Forestry.

The Forest Policy of Pennsylvania. George H. Wirt. Reviews the policy of this State in the past, and discusses what it should be in the future. 5600 w. Jour Fr Inst—May, 1903. No. 55156 D.

Granite.

The Granite Industry of Maine. An illustrated article giving the location of some of the extensive deposits and information concerning the quality of the stone. 2000 w. Stone—April, 1903. No. 55183 C.

Slag Bricks.

The Manufacture of Slag Bricks and Slag Blocks. Edwin C. Eckel. Describes these products in detail. 3300 w. Eng News—April 30, 1903. No. 55087.

Slag Cement.

Portland Cement Manufactured from Blast-Furnace Slag. Chevalier C. de Schwarz. A paper before the Iron and

Steel Institute, giving a statement of the advantages and disadvantages of this product, for what uses adapted, etc., giving results of recent tests, and other information. 3500 w. Ir & Coal Trds Rev—May 8, 1903. No. 55330 A.

Timber.

I. The Use of Timber by Railroads and Its Relation to Forestry. Dr. Hermann von Schrenk. II. Railroad Interests in Forest Supplies. Prof. B. E. Fernow. Two papers on timber supply and preservation; followed by general discussion. Ill. 18000 w. N Y R R Club—April 17, 1903. No. 55291.

Wood Preservation.

Apparatus for and Methods of Treating Wood, to Protect It from Fire and Preserve It from Decay. Joseph L. Ferrell. Reviews the processes used for the protection from the attacks of flame and fungus. General discussion. 10500 w. Pro Engrs Club of Phila—April, 1903. No. 55164 D.

MEASUREMENT.

Arc of Meridian.

Report of the Commission for Geodetic Work at the Equator (Rapport Présenté au Nom de la Commission chargée du Contrôle Scientifique des Operations Géodésiques de l'Equateur). H. Poincaré. An account of progress made in measuring an arc of the meridian near Quito, Ecuador. 2800 w. Comptes Rendus—April 6, 1903. No. 54873 D.

Beams.

The Deflection of Beams when Unsymmetrically Loaded. P. P. Bredsten. Gives a time-saving diagram with brief explanation of its use. 200 w. Am Mach—April 30, 1903. No. 54985.

Bending Moments.

Curves of Maximum Bending Moment. Arthur L. Bell. Describes method of plotting the actual curves of maximum bending moment. 2400 w. Engr, Lond—May 8, 1903. No. 55285 A.

Cable Tension.

The Arnodin System of Measuring Cable Tension (Note sur les Cables Témoins, Système F. Arnodin). F. Arnodin. An illustrated description of a system of measuring the tension of cables and ropes by means of an auxiliary cable which is made to have the same curvature and which is connected to a dynamometer. 2500 w. Mem Soc Ing Civils de France—March, 1903. No. 55406 G.

Curves.

Special Methods of Determining Groups of Curves Representing Engineering Formulæ. W. F. Durand. Describes methods the use of which, where applicable, will effect a great saving of labor. 3000 w. Sib Jour of Engng—May, 1903. No. 55190 C.

Graphic Statics.

On the Use of Influence Lines in Graphic Statics. Myron S. Falk. Shows its use to indicate the position of the moving load causing the maximum shears, moments, reactions, or stresses in a truss. 3800 w. Sch of Mines Quar—Jan., 1903. No. 55154 D.

Riveted Joints.

The Polar Moment of Inertia, and Its Graphical Application to Riveted Joints. C. F. Blake and R. W. Runge. Mathematical discussion. 2500 w. Eng News—May 21, 1903. No. 55322.

MUNICIPAL.

Accounting.

Municipal Accounting. A discussion at the meeting of the National Conference for Good City Government, and the National Municipal League, concerning the need of uniformity, that statistics may be made of greater value. 2800 w. Eng Rec—May 2, 1903. No. 55118.

Asphalt.

Asphalt Experiments at Washington. Abstract of the report made by A. W. Dow, concerning investigations on asphalt for paving purposes. 1500 w. Eng Rec—May 2, 1903. No. 55117.

Drainage.

Power and Pumping Stations of the New Orleans Drainage System. W. M. Venable. Gives the general outlines of the drainage problems presented by the district and the plan adopted, and describes specifically the installations and operation of the pumping stations completed and the central station from which all are furnished with electric power. Illustrated. 4800 w. The Engineering Magazine—June, 1903. No. 55495 B.

Garbage.

An Investigation of a Garbage Crematory. Extracts from a report by Rudolph Hering to the Special Committee on Crematory of the City Council of Trenton, N. J. Descriptive. 3500 w. Sci Am Sup—May 16, 1903. Serial. 1st part. No. 55248.

Pavements.

How to Lay Brick Pavements. A digest of the model specifications used in Rochester, N. Y., where many miles of brick pavements are in good condition after hard service. 3500 w. Munic Jour & Engr—May, 1903. No. 55039 C.

See also Street and Electric Railways.

Sewerage.

Swampscott Sewerage System. Describes a system for this town on Massa-

chusetts Bay. All the sewage is collected in a receiving basin and pumped through an 18-in. cast-iron pipe 2,200 feet to the shore, and from there directly out to sea, 3,600 ft. further. Ill. 1400 w. Eng Rec —May 23, 1903. No. 55356.

WATER SUPPLY.

Atlantic City.

Atlantic City Water-Works. An illustrated description of the system. The sources of supply are artesian wells, and Absecon creek. 1800 w. Fire & Water —May 23, 1903. No. 55336.

Brussels.

The Water Supply of Brussels in 1902 (Les Eaux de Bruxelles en 1902). E. d'Esmenard. An abstract of a report by E. Putzeys, chief engineer, on the water supply and service of Brussels. 2000 w. Rev Technique—April 10, 1903. No. 55420 D.

California.

Rainfall on the Pacific Coast of North and South America and the Factors of Water Supply in California. Marsden Manson. Shows the variations in the rainfall, considering how this, with other factors, controls the water supply, the storage facilities, and related subjects. Map. 5000 w. Jour Assn of Engng Soc's—March, 1903. No. 55158 C.

Ground Water.

The Rapidity of Flow of Ground Water (Sur la Vitesse d'Ecoulement des Eaux Souterraines). E. Fournier and A. Magnin. An account of experiments on the flow of subterranean waters, with particular reference to their use for drinking. 500 w. Comptes Rendus—April 6, 1903. No. 54874 D.

Laboratories.

Biological and Chemical Laboratories of the Water Department of New York City. George C. Whipple. A review of the work carried on at these laboratories, the supervision, tests, analyses, and sanitary investigations. 2500 w. Eng Rec—May 9, 1903. No. 55147.

Philadelphia.

The Center Square Water-Works of Philadelphia; the Source of Water Supply from 1801 to 1815. A brief sketch of the early history of the Philadelphia supply, with illustrated description of the first pumping station, and the wooden boilers used. 1700 w. Engs News—May 14, 1903. No. 55216.

Reservoirs.

The Utilization of Utah Lake as a Reservoir. W. P. Hardesty. Describes this lake, which is about 30 miles from Salt Lake City, showing that it is almost a natural reservoir. Gives an account of efforts to utilize more of the water by pumping, and discusses its possibilities as a reservoir. Ill. 5800 w. Eng News—May 21, 1903. No. 55318.

See also Civil Engineering, Construction.

ELECTRICAL ENGINEERING

COMMUNICATION.

Automatic Telephone.

Automatic Telephone Systems. A. Dallam O'Brien. The present article gives an illustrated description of the Ness interior system. 1600 w. Am Elect'n—May, 1903. No. 55112.

Cable Testing.

Some Notes on Cable Testing. W. Dalton. The first of a series of articles giving practical points on cable testing, illustrated by examples. 2500 w. Elec Engr, Lond—April 24, 1903. Serial. 1st part. No. 55008 A.

Printing Telephone.

A Sketch for a Type-Printing Telephonograph (Skizze zu einem Typen-Druck-Telephonographen). W. Krejza. A suggestion, with diagram, for a system using selective receiving telephones, each of which would respond to the sound corresponding to a letter and would operate a relay which would actuate the type-printing mechanism. 500 w. Zeitschr f Elektrotechnik—April 12, 1903. No. 55473 D.

Space Telegraphy.

Hertzian Wave Wireless Telegraphy. Dr. J. A. Fleming. The first of a series of articles giving an account of the present condition of electric-wave telegraphy. The discussion is limited to an account of the scientific principles underlying the operation of this particular form of wireless telegraphy. 10700 w. Ill. Pop Sci M—June. Serial. 1st part. No. 55394 C.

De Forest Wireless Telegraph System. A. Frederick Collins. An illustrated description of this system, and particularly of the receiving apparatus which employs an electrolytic responder, whose resistance increases upon the impact of the electric waves. 1600 w. Elec Wld & Engr—April 11, 1903. No. 54996.

Branly-Popp Aerial Telegraphy System. Brief illustrated description of this sys-

tem and an account of the schemes in Paris to operate it. 1500 w. Elec Wld & Engr—May 16, 1903. No. 55225.

Some Problems in Space Telegraphy. Joseph B. Baker. Discusses principally the subject of tuning, and the progress made. 2000 w. Elec Rev, N. Y.—May 16, 1903. No. 55222.

Space Telephony.

Wireless Telephonic Communication Between Moving Ferry Boats. Dr. T. Byard Collins. An illustrated account of the experiments made by A. Frederick Collins in New York Harbor. 1100 w. Sci Am—May 23, 1903. No. 55315.

Telephone Exchange.

The New Brussels Telephone Exchange. An illustrated description of an exchange designed in accordance with the recommendations of a commission appointed to investigate modern systems. 1500 w. Elec Wld & Engr—May 2, 1903. No. 55076.

Telephone Service.

Telephone Service. S. J. Larned. A discussion of its value, and of the organization and methods of good service. 6000 w. Jour W Soc of Engrs—April, 1903. No. 54993 D.

Telephone Switchboards.

Divided Multiple Switchboards: An Efficient Telephone System for the World's Capitals. W. Aitken. Abstract. Considers methods used, and the common battery system, and describes the system suggested. 2500 w. Elec Rev, Lond—May 15, 1903. Serial. 1st part. No. 55366 A.

Telephone Wires.

The Tension of Telephone Wires. Pierre Vandeuren. Calculations relating to steel lattice work poles, carrying large numbers of wires. 12200 w. 1 table and figure. Bul International Ry Cong—April, 1903. No. 55381 E.

DISTRIBUTION.

Alternating Current.

Grounding of Alternate Current Systems. George N. Eastman. Presents a few problems with diagrams showing conditions which may arise and produce very disastrous results. 2500 w. Jour W Soc of Engrs—April, 1903. No. 54995 D.

Capacity.

Capacity Relations in Cables (Kapacitätsverhältnisse in Kabeln). Dr. H. Andriessen. A theoretical discussion of the electrostatic capacity of cables, taking the most general case. 1600 w. Elektrotech Zeitschr—April 30, 1903. No. 55456 B.

Network Calculations.

A Simple Method for the Calculation of Closed Conducting Networks (Eine Einfache Methode zur Berechnung von Geschlossenen Leitungsnetzen). Dr. H. Gallusser. A graphical and mathematic method for calculating the current distribution in networks. Diagrams. 2000 w. Elektrotech Zeitschr—April 23, 1903. No. 55455 B.

Safety Devices.

Safety Devices for High-Tension Alternating-Current Lines (Sicherungen für Wechselstrom — Hochspannungsleitungen). Franz Probst. An illustrated description of safety devices to protect electric lines and apparatus against excessive currents and excessive pressures, including fuses, lightning arresters, etc. Serial. 2 Parts. 5000 w. Zeitschr f Elektrotechnik—March 29 and April 5, 1903. No. 55469 each D.

Standards.

Standards for Conductors (Normalien für Leitungen). Standards for electric conductors and cables for all kinds of purposes, proposed by a Committee of the Verband Deutscher Elektrotechniker. 2000 w. Elektrotech Zeitschr—May 7, 1903. No. 55462 B.

Sub-Stations.

The Development, Equipment, and Operation of the Sub-Stations and Distributing Systems of the Chicago Edison Co. and Commonwealth Electric Co. Ernest F. Smith. General description of methods and details. 4800 w. Jour W Soc of Engrs—April, 1903. No. 54994 D.

Switches.

See Electrical Engineering, Generating Stations.

ELECTRO-CHEMISTRY.

Accumulator.

The Tribelhorn Accumulator (Les Accumulateurs Tribelhorn). L. Brossement. An illustrated description of an accumulator in which the active material is placed on opposite sides of saucer-shaped elements, which are then piled on top of each other, and separated by glass balls, to form a battery. 600 w. Rev Technique—April 10, 1903. No. 55419 D.

Address.

Electro-Chemistry (Ueber Elektrochemie). Viktor Engelhardt. An address, giving a general review. 2000 w. Zeitschr d Oesterr Ing u Arch Ver (Supplement)—March 20, 1903. No. 55478 B.

Bipolar Electrodes.

Bipolar Electrodes (Ueber Bipolare Elektroden). André Brochet and C. L. Barillet. An account of experiments in the Laboratorie d'Electrochimie, Ecole de Physique et de Chimie Industrielles de Paris, with bipolar electrodes, or metal partitions in electrolytic cells which act as

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both anodes and cathodes. 2600 w. Zeitschr f Elektrochemie—March 26, 1903. No. 55485 G.

Bipolar Electrodes and Metal Diaphragms (Ueber Zweipolige Elektroden und Metalldiaphragmen). H. Danneel. An account of experiments, at the Institut für Metallhüttenwesen und Elektrometallurgie, in Aachen, with bipolar electrodes, or metal partitions in electrolytic cells which act as both anode and cathode; also discussion of experiments of Messrs. Brochet and Barillet. 2500 w. Zeitschr f Elektrochemie—March 26, 1903. No. 55486 G.

Dissociation Theory.

Some Applications of the Electrolytic Dissociation Theory to Medicine and Biology. Wilder D. Bancroft. Lecture before the Am. Phil. Soc. A critical summary of the achievements in medicine and biology, due to applications of the dissociation theory. 3000 w. Elec-Chem Ind —May, 1903. No. 55239 C.

Electric Furnace.

The Application of the Electrical Furnace in Metallurgy. Albert Keller. A paper before the Iron and Steel Institute, which considers this subject, the figures given being based on experiments carried out on an industrial scale at various electric works driven by water power. 7000 w. Ir & Coal Trds Rev—May 8, 1903. No. 55329 A.

Electroplating.

The Electrodeposition of Metals on Rotating Cathodes. Abstract of paper by J. G. Zimmerman, read before the Am. Elec.-Chem. Soc. Showing that in electroplating smooth deposits can be obtained with comparatively high current densities, if the cathode is revolved. 900 w. Elec-Chem Ind—May, 1903. No. 55241 C.

Metallic Compounds.

Electrolytic Production of Metallic Compounds. Prof. C. F. Burgess and Carl Hambruchen. Abstract of paper read before the Am. Elec.-Chem. Soc. An account of experimental study of various processes, especially for the production of white lead. 3700 w. Elec-Chem Ind—May, 1903. No. 55240 C.

Platinum.

The Electrolytic Dissolving of Platinum by Means of Alternating Currents (Ueber die Elektrolytische Auflösung von Platin Mittels Wechselströmen). Rudof Ruer. An account of experiments on the solubility of platinum in different electrolytes under the influence of alternating electric currents, and theoretical discussion. 2500 w. Zeitschr f Elektrochemie—March 19, 1903. No. 55484 G.

Zinc Extraction.

See Mining and Metallurgy, Miscellany.

ELECTRO-PHYSICS.

Arc Converters.

Pulsating Direct Currents in Alternating Current Electric Arcs (Pulsierende Gleichströme im Wechselstromlichtbogen). Berthold Monasch. Address before the Elektrotech. Verein of the Darmstadt Technical School, in which, apropos of the Cooper-Hewitt converter, a review is given of former methods of deriving pulsating direct currents from alternating current arcs. 2500 w. Elektrotech Zeitschr —April 30, 1903. No. 55457 B.

Coherers.

Coherer Action Under the Microscope. G. T. Hanchett. Gives an experimental microscopic investigation, deducing the requirements for a good coherer. 700 w. Elec Rev, N. Y.—May 2, 1903. No. 55085.

Electric Convection.

On Electric Convection (Sur la Convection Electrique). M. Vasilesco-Karpen. An account of experiments to show that a moving electrified body produces a magnetic field, as first proved by Rowland. 700 w. Comptes Rendus—March 9, 1903. No. 54865 D.

Researches in Electric Convection (Recherches sur la Convection Electrique). V. Crémieu and H. Pender. An account of experiments to determine the influence of a moving electrified body on a magnet. 600 w. Comptes Rendus—April 20, 1903. No. 54877 D.

Electrons.

Ions and Electrons. Abstract of a paper by Dr. Louis A. Parsons, read before the Am. Elec.-Chem. Soc. A review of investigations which led to the modern electronic hypothesis. 1200 w. Elec-Chem Ind —May, 1903. No. 55242 C.

Hysteresis.

Magnetic Hysteresis at High Frequencies (Sur l'Hystérésis Magnétique aux Fréquences Elevées). C. E. Guye and B. Herzfeld. An account of experiments with frequencies up to 1,200 per second, tending to show that the hysteresis energy loss per cycle is independent of the frequency. 700 w. Comptes Rendus—April 20, 1903. No. 54878 D.

Magnetization Curve.

Calculation of the Magnetization Curve (Rechnerische Ermittelung der Magnetisierungskurve). Iwan Döry. Formulæ and methods of calculating the magnetization curve of iron which give results agreeing very well with those observed. 1000 w. Zeitschr f Elektrotechnik—March 29, 1903. No. 55470 D.

Radio-Activity.

Radium. Prof. J. J. Thomson. The radio-activity of radium is explained by the hypothesis that some of the atoms of radium are in an unstable condition and

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that in passing into other configurations they give out a large amount of energy. 1400 w. Nature—April 30, 1903. No. 54863 A.

The Radiation from Polonium and the Secondary Radiation which it Produces (Sur le Rayonnement du Polonium et sur le Rayonnement Secondaire qu'il Produit). Henri Becquerel. An account of experiments with radioactive substances. 1200 w. Comptes Rendus—April 27, 1903. No. 54880 D.

A New Kind of Light (Sur une Nouvelle Espèce de Lumière). R. Blondlot. An account of experiments with rays from a tube, which can be reflected, refracted and polarized. 700 w. Comptes Rendus—March 23, 1903. No. 54871 D.

Radium, Radioactivity and Hypotheses (Le Radium—la Radioactivité — Hypothèses). Paul Besson. A review of radioactive phenomena, and hypotheses of the constitution of matter and the propagation of light. 4000 w. Mem Soc Ing Civils de France—March, 1903. No. 55410 G.

On the "Emanation Substance" from Pitchblende, and on Radium. F. Giesel. An account of researches. 2000 w. Sci Am Sup—May 16, 1903. No. 55246.

Radium and Its Position in Nature. William Ackroyd. Gives a brief account of the discovery of this element, its rarity, properties, etc., discussing its scientific value. 4500 w. Nineteenth Cent—May, 1903. No. 55259 D.

Some Recent Advances in Radioactivity. Frederick Soddy. An account of the researches of Professor Rutherford and his co-workers at McGill University. 6000 w. Contemporary Rev—May, 1903. No. 55215 D.

Stereoscopic Radioscopy (Procédé de Radioscopie Stéréoscopique). Th. Guilloz. Description of an arrangement of Roentgen-ray apparatus which gives good stereoscopic vision in examinations of the human body. 600 w. Comptes Rendus—March 9, 1903. No. 54866 D.

A Stereoscope for Röntgen Ray Photographs. Describes an ingenious direct-vision stereoscope, devised by Dr. Walter, of Hamburg, capable of viewing photographs of any size. Ill. 1400 w. Elec Rev, Lond—April 24, 1903. No. 55009 A.

Spark Phenomena.

The Projection of Matter About an Electric Spark (Sur la Projection de la Matière autour de l'Etincelle Electrique). Jules Semenov. An account of experiments with electric discharges through flames, showing that the transport of matter from one electrode to another is only a secondary phenomenon. 600 w. Comptes Rendus—April 14, 1903. No. 54875 D.

Thermo-Electricity.

Thermo-Electromotive Force Without Difference of Temperature. Abstract of a paper by Prof. Henry S. Carhart, read before the Am. Elec.-Chem. Soc. On the thermodynamical theory of galvanic cells. 2300 w. Elec Chem Ind—May, 1903. No. 55243 C.

GENERATING STATIONS.

Aberdeen.

The New Aberdeen Electricity Works. Illustrated detailed description of a new generating station in Scotland. 3500 w. Elec Rev, Lond—May 1, 1903. No. 55195 A.

Bank, Pittsburg.

Electrical Equipment of the Farmers' Bank Building, Pittsburg. L. L. Emerson. Describes an alternating-current system of electric service; an extensive power plant has been installed and the entire building wired for illumination by the Nernst lamp. Ill. 1600 w. Eng Rec—May 9, 1903. No. 55148.

Chicago.

Recent Development of the Chicago Edison and Commonwealth Electric Systems. An account of the remarkable progress in this field, describing the great Fiske Street station, now under construction, designed for the use of 5,000-kw. Curtis steam turbine units and other interesting apparatus to be installed. Also describes briefly other stations of interest. Ill. 4800 w. Elec Wld & Engr—May 23, 1903. No. 55515.

Compounding.

The Compounding of Self-Excited Alternating Current Generators for Variation in Load and Power Factor. A. S. Garfield. A description of the characteristics of a polyphase alternating current revolving field generator provided with a single closed-circuit field-winding and commutator. Ill. 1800 w. Am Inst of Elec Engrs—May 19, 1903. No. 52294 D.

Consolidations.

Centralized Management of Electrical Properties. H. S. Knowlton. Showing the gains which may sometimes be attained by consolidation and centralized management. 1600 w. Elec Wld & Engr—May 23, 1903. No. 55518.

De Kalb, Ill.

A Very Modern Central Station of Medium Size. J. R. Cravath. An illustrated description of the central station at De Kalb, Ill., and its equipment. 2200 w. Am Elect'n—June, 1903. No. 55526.

Dynamo Troubles.

Failure of Direct Current Dynamos to Generate. E. C. Parham. Considers some of the causes of disorder leading to a failure of the dynamo to do its duty. 1500 w. Am Elect'n—May, 1903. No. 55113.

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Electro-Plating.

Design for a 150-Ampere Electro-Plating Dynamo. Cecil P. Poole. Reproductions of working drawings with descriptive notes. 1800 w. Am Elect'n—June, 1903. No. 55529.

Everett, Wash.

Design of the New Power Plant and System of the Everett Railway & Electric Co. Edward P. Burch. From a recent address before the students in power plant design at Minnesota State Univ. Illustrates and describes this plant for a city in Washington. 3000 w. St Ry Rev—May 20, 1903. No. 55307 C.

Field Coils.

Field Coil Formulas. Thorburn Reid. Gives approximate equations deduced by the writer and used constantly in calculating the weight of copper, depth of coil, number of turns, size of wire, etc., in field coils. 1800 w. Elec Wld & Engr—May 16, 1903. No. 55226.

Government Printing Office.

Power Plant of the Government Printing Office at Washington. An illustrated detailed description of the enlarged plant which is to serve the new office and the old adjacent plant. The present article describes the boiler plant. 2300 w. Eng Rec—May 16, 1903. Serial. 1st part. No. 55230.

Hydro-Electric.

Design of Electric Water Power Stations. Alton D. Adams. Describes types of water-power stations in detail, with methods of driving, and features of interest. Ill. 4000 w. Elec Rev, N. Y.—May 23, 1903. No. 55511.

Water Power in Electrical Supply. Alton D. Adams. Reviews the development of electric water power systems in America, giving information of interest. 2500 w. Elec Rev, N. Y.—May 9, 1903. No. 55133.

Maintenance and Operation of Central Stations by Water-Power. George S. Carson. Read before the Iowa Elec. Assn. Reports concerning an installation on the Iowa river and briefly discusses the subject generally. 2000 w. Engr, U S A—May 15, 1903. No. 55237 C.

Small Water Powers with High Heads for Electric Lighting. Thorburne Reid. Suggestions for the utilization of such streams, describing a plant in detail. 2500 w. Cassier's Mag—May, 1903. No. 55-178 B.

See also Civil Engineering, Canals, Rivers and Harbors.

Italy.

Great Electric Installations of Italy. The Hydro-Electric Station of Cenischia. Enrico Bignami. Illustrated description of the hydraulic and electric features of a characteristic Alpine station designed to use 1,400 litres per second under a head of 859 metres. Illustrated. 3000 w. The Engineering Magazine—June, 1903. No. 55496 B.

Kansas City.

The Central Avenue Power Station. H. S. Badger and G. E. Schreiber. An illustrated detailed description of a recent installation in Kansas City, Kan. 6500 w. Power—May, 1903. No. 55067 C.

Load Diagrams.

See Street and Electric Railways.

Massachusetts.

Statistics of the Massachusetts Electrical Supply System in 1902. Alton D. Adams. 2500 w. Elec Wld & Engr—May 23, 1902. No. 55517.

Municipal Plants.

Investments and Earnings of Municipal Electric Plants. Alton D. Adams. Aims to determine the ratio of net earnings to investments in plants built by towns in Massachusetts, comparing the results with the ratio in similar plants owned by private corporations. 1800 w. Munic & Engng—May, 1903. No. 55184 C.

Municipal Electricity Undertakings. Claims that municipal balance sheets are not kept in a way that shows the actual state of affairs. Gives example, analyzing balance sheets. 1400 w. Elec Rev, Lond—May 15, 1903. No. 55368 A.

N. Y. Stock Exchange.

The New Headquarters of the Stock Exchange, New York City. An illustrated description of the power plant, annunciator service, and telephone system. 3800 w. Elec Rev, N. Y.—May 9, 1903. No. 55134.

Pontiac, Ill.

The Pontiac Light and Water Co., Pontiac, Ill. An illustrated account of a company uniting most of the public utilities under one management, for a town of about 6,500 inhabitants. 3200 w. Elec Wld & Engr—May 23, 1903. No. 55516.

Records.

Notes on the Design of Central-Station Records and Returns. F. H. Davis. Notes describing the practice in several well-managed stations. 6000 w. Elec Engr, Lond—May 8, 1903. No. 55273 A.

Regulation.

The Experimental Basis for the Theory of the Regulation of Alternators. B. A. Behrend. Aims to supply data to enable the Committee on Standardization to draw up rules for the determination of voltage regulation. 4700 w. Am Inst of Elec Engrs—May 19, 1903. No. 55295 D.

Spezia Arsenal.

The Electric Plant of the Royal Arsenal at Spezia, Italy (L'Impianto Elettrico del

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R. Arsenale di Spezia). Attilio Incontri. An illustrated description of an alternating and direct-current plant for light and power at this naval station. 12 plates. 6000 w. Rivista Marittima—Feb., 1903. No. 55489 H.

Sugar Refinery.

See Mechanical Engineering, Miscellany.

Switches.

The Design of Switching Apparatus for High Tension Central Stations (Ueber den Entwurf von Schaltanlagen für Hochspannungszentralen). Dr. Benischke. A paper giving an illustrated description of modern high-tension switching apparatus. 3000 w. Zeitschr f Elektrotechnik—March 15, 1903. No. 55467 D.

Teplitz-Schonau.

The Municipal Electrical Works at Teplitz-Schönau, Bohemia (Das Städtische Elektrizitätswerk in Teplitz-Schönau). A Frühwirth. An illustrated description of the station and distributing three-wire system, their cost and the charges for current. 3500 w. Zeitschr d Oesterr Ing u Arch Ver—March 13, 1903. No. 55475 B.

Wiesberg.

The Wiesberg Electric Station (Das Elektricitätswerk Wiesberg). W. Stoeger. An illustrated description of a hydro-electric station in the Tyrol, for supplying the district about Landeck with current for electrochemical and other purposes. 1600 w. Elektrotech Zeitschr—May 14, 1903. No. 55464 B.

LIGHTING.

Illumination.

The Engineering of Illumination. Van Rensselaer Lansingh. Considers the factors consituting good illumination, and the principles of interior illumination, especially in buildings for public use. Ill. 7800 w. Jour W Soc of Engrs—April, 1903. No. 54990 D.

Isolated Plants.

The Economy of Isolated Electric Light Equipments in Small Factories. F. O. Runyon. A short article showing the cost of installing and maintaining such plants. 1200 w. Elec Rev, N. Y.—May 16, 1903. No. 55223.

Lamp Manufacture.

The Manufacture of Incandescent Lamps. Describes the making of incandescent electric lamps as carried on at the works of the Sir Hiram Maxim Electrical and Engineering Company. Ill. 5700 w. Engng—May 8, 1903. No. 55281 A.

MEASUREMENT.

Differential Telephone.

The Use of Differentially Wound Telephone Receiver in Electrical Measurements. Prof. H. Ho. Calls attention to the uses which can be made of the differential telephone for the purposes of measurement. 700 w. Elec Wld & Engr—May 23, 1903. No. 55519.

Galvanometer.

A Recording Galvanometer and a Revolving Contact and their Employment in Tracing Alternating-Current Curves (Sur un Galvanomètre Enregistreur et un Contact Tournant, et sur leur Emploi au Tracé des Courbes de Courants Alternatifs). J. Carpentier. A description of two pieces of apparatus, which may be used independently or together. 700 w. Comptes Rendus—April 20, 1903. No. 54879 D.

Iron Tests.

Apparatus for Making Magnetic Tests of Entire Sheets of Iron (Eisenprüfapparat für Ganze Blechtafeln). Rudolf Richter. An illustrated description of a large cylindrical apparatus used by Siemens & Halske for making electromagnetic tests of whole sheets of iron for electric apparatus. 1800 w. Elektrotech Zeitschr—May 7, 1903. No. 55458 B.

Magnetometer.

An Apparatus for Exploring Feeble Magnetic Fields (Nouveaux Systèmes Magnétiques pour l'Etude des Champs Très Faibles). V. Cremieu and H. Pender. A description of a magnetometer consisting of a small horizontal arm suspended by a fine wire, with a vertical magnet at one end and a counterweight at the other. This arrangement may be applied also in a sensitive galvanometer. 600 w. Comptes Rendus—March 9, 1903. No. 54864 D.

Oscillograph.

Blondel Oscillograph. Henry Hale. Illustrated description of the latest form of this apparatus which gives a visual representation of alternating-current waves. 1400 w. Elec Wld & Engr—May 2, 1903. No. 55077.

Potentiometer.

The Crompton Potentiometer for Electrical Measurements with Direct Current Supply. Illustrates and describes this instrument which is in use in many electric lighting and power stations in England. 1500 w. Sci Am Sup—May 16, 1903. No. 55249.

Thermostat.

An Electric Thermostat (Sur un Thermostat à Chauffage et Régulation Electriques). C. Marie and R. Marquis. An illustrated description of a bath for physical experiments which is heated by an electric current and whose temperature is regulated very closely by an electric thermostat. 200 w. Comptes Rendus—March 9, 1903. No. 54867 D.

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Watt-Hour Meters.

Report of the Reichsanstalt on Aron Meters (Mitteilungen der Physikalisch-Technischen Reichsanstalt. Bekanntmachung über Prüfungen und Beglaubigungen durch die Elektrischen Prüfämter). A report and certification from the electrical testing bureau of the Reichsanstalt, Charlottenburg, Germany, giving an illustrated description of Aron watt-hour meters for direct and for alternating current. 1600 w. Elektrotech Zeitschr—May 14, 1903. No. 55463 B.

POWER APPLICATIONS.

Coal Mining.

Electrical Apparatus for Coal-Mining. W. B. Clarke. Discusses recent developments in connection with electrical apparatus for the mining of coal. 4000 w. Trans Am Inst of Min Engrs—Feb., 1903. No. 55385.

Electrical Apparatus for Coal-Mining. W. L. Saunders. Remarks made in discussing the paper on this subject by W. B. Clarke, at the Albany meeting of the Am. Inst. of Min. Engrs. 5000 w. Compressed Air—May, 1903. No. 55520.

Control.

Shunt-Field and Variable Voltage Control for Electric Motors. William Cooper. Extracts from a paper read before the Cincinnati Chapter of the Am. Inst. of Elec. Engrs. Gives a useful diagram and explains a system of determining the minimum size motor. 3400 w. Am Mach—April 30, 1903. No. 54986.

Drills.

Electric Mining Drills Abroad. Frank C. Perkins. Illustrated description of Siemens & Halske and other drills as used in German mines. 3000 w. Mines & Min—May, 1903. No. 55055 C.

Elevators.

Induction Motors for Elevators. A. B. Weeks. An illustrated description of some of the apparatus employed and notes on the care of it. 1500 w. Am Elect'n—June, 1903. No. 55530.

Glass Works.

Induction Motors in a Plate Glass Factory. J. R. Cravath. Brief illustrated description of the plant of the Edward Ford Plate Glass Co., near Toledo, Ohio. 800 w. Am Elect'n—May, 1903. No. 55109.

Heyland Motor.

A Study of the Heyland Machine as a Motor and Generator. Comfort A. Adams. A report of experimental work, with a review of the history and general theory. Ill. 13000 w. Am Inst of Elec Engrs—May 19, 1903. No. 55296 D.

The Heyland Single-Phase Motor (Der Einphasenmotor System Heyland in Seiner Heutigen Ausführung und Verwendung). André Schmidt. An illustrated description of this single-phase alternating-current motor which can start under load, and its present applications. 2500 w. Elektrotech Zeitschr—May 7, 1903. No. 55460 B.

Induction Motors.

The Induction Motor. George T. Hanchett. Describes the electrical and mechanical characteristics, explaining the general principle of the machine. Ill. 3000 w. Cent Sta—May, 1903. No. 55258.

Lathe.

See Mechanical Engineering, Machine Works and Foundries.

Locks.

See Civil Engineering, Canals, Rivers and Harbors.

Machine Shop.

The Development and Use of the Small Electric Motor. III. The Choice of Motors for Machine Shop and Factory. Fred. M. Kimball. This third paper in the current series describes the types of motors and discusses their choice, installation, and daily operation from the standpoint of the power user. It gives some valuable data of power required for various machines and of running costs. Illustrated. 5000 w. The Engineering Magazine—June, 1903. No. 55497 B.

Electric Driving in Machine Shops, Engineering and Shipbuilding Works. Reviews the papers by A. B. Chatwood and by A. D. Williamson, dealing with this subject. 1700 w. Elec Rev, Lond—May 15, 1903. Serial. 1st part. No. 55365 A.

The Wüst System of Driving Machine Tools and Hoisting Machinery. Illustrates and describes the Wüst patent multi-speed polyphase motor and its working. 2000 w. Elec Rev, Lond—May 1, 1903. No. 55197 A.

Driving Planers. J. C. Steen. Remarks on the variable power required as revealed by the individual motor drive. 600 w. Am Engr & R R Jour—May, 1903. No. 55073 C.

Mining.

Electricity in Mines. Reports to the Departmental Committee on Electricity in Mines, including an account of valuable experiments to test the liability of continuous-current motors on coal-cutters to ignite gas, undertaken and reported by W. E. Garforth. Ill. 3300 w. Col Guard—May 1, 1903. No. 55203 A.

The Motive Power of the Future. Horace D. B. How. Abstract of a paper read before the South Wales Inst. of Engrs. An illustrated article considering the possibilities of electrical power at present and the future outlook. 3000 w. Ir & Coal Trds Rev—May 1, 1903. No. 55207 A.

We supply copies of these articles. See page 638.

Mining Pumps.

Alternating and Direct Current Mining Pumps. Frank C. Perkins. Describes successful types of electric pumping plants, giving information of interest. Ill. 2000 w. Min Rept—May 14, 1903. No. 55251.

Polyphase Motors.

The Theory and Operation of Polyphase Motors with Commutators and Shunt Excitation (Beitrag zur Theorie und Wirkungsweise der Mehrphasigen Kommutatormotoren mit Nebenschlusserregung). O. S. Bragstad. An illustrated theoretical and descriptive discussion of these electric motors. Serial. Part 1. 1800 w. Elektrotech Zeitschr—May 14, 1903. No. 55465 B.

Polyphase Motor Installations. The first of a series of papers aiming to give in a brief and simple manner such information as will enable the engineer in charge, who has no special knowledge of electrical matters, to understand the plant put under his care. 4000 w. Prac Engr—April 24, 1903. Serial. 1st part. No. 55002 A.

The Winter-Eichberg System for Regulating the Speed of Polyphase Motors (Regulierbare Drehstrommotore. System Winter-Eichberg). G. Winter. An illustrated description of a polyphase motor in which the rotor has an auxiliary winding and a commutator, with brushes connected to a transformer which can be varied. 1500 w. Zeitschr f Elektrotechnik—April 12, 1903. No. 55471 D.

Shipyard.

Electric Installation of the Vulcan Shipyard. A. Richardson. Gives an illustrated detailed description of the re-equipment of this important shipbuilding establishment in Germany. 6500 w. Trac & Trans—May, 1903. Serial. 1st part. No. 55277 E.

TRANSMISSION.

Address.

Electric Transmission of Power (Ueber Elektrische Kraftübertragung). Friedrich Drexler. An address, giving general historical and descriptive review of electric power transmission. 2 plates. 4000 w. Zeitschr d Oesterr Ing u Arch Ver (Supplement)—March 20, 1903. No. 55477 B.

France.

The Distribution of Electrical Energy at 20,000 Volts in the Department of the Aude. Enrico Bignami. An illustrated detailed description of a system with 400 kilometres (250 miles) of lines. 3500 w. Elec Rev, N Y—May 23, 1903. No. 55513.

Greece.

Power Transmission in Greece. Illustrates and describes a recently completed plant for the utilization of water power and the transmission of energy—the plant of the Lake Copais Co., Ltd. 1200 w. Elec Rev, Lond—May 8, 1903. No. 55274 A.

Long Distance.

Some Difficulties of Long-Distance Electrical Transmission. P. M. Lincoln. Address delivered before the Cleveland Elec. Club. Considers some of the troubles that arise and means of avoiding some of them. General discussion. 4500 w. Engr, U S A—May 1, 1903. No. 55084 B.

The Continuous and Alternating Current. Alton D. Adams. Considers the relative advantages of each for power transmission as shown on long-distance lines in Switzerland. 3200 w. Mines & Min—May, 1903. No. 55058 C.

Polycyclic System.

The Arnold-Bragstadt-La Cour Polycyclic Power-Transmission. O. S. Bragstadt. An illustrated description of a composite system of transmission. 2500 w. Elec Wld & Engr—May 9, 1903. No. 55141.

MISCELLANY.

Coat of Mail.

Artemiev's Electrical Coat of Mail. Emile Guarini. An illustrated article describing this garment for affording protection against high electrical tensions. 600 w. Sci Am—May 16, 1903. No. 55244.

Electric Clock.

The David Perret Electric Clock. Emile Guarini. An illustrated description of a clock invented by a Swiss electrician. 1100 w. Sci Am Sup—May 30, 1903. No. 55525.

Europe.

Notes on Recent Electrical and Scientific Developments. William J. Hammer. An illustrated article describing details of the Valtellina 20,000-volt three-phase railway in Italy; three-phase Cruto, and Ganz lamps, Osmium and Nernst lamps. 4400 w. Jour Fr Inst—May, 1903. Serial. 1st part. No. 55155 D.

Irish Bogs.

See Industrial Economy.

Lightning Protection.

Report of a Committee of the Elektrotechnischer Verein on the Protection of Electric Plants Against Atmospheric Discharges (Bericht des Technischen Ausschusses des Elektrotechnischen Vereins über den Schutz Elektrischer Starkstromanlagen Gegen Atmosphärische Entladungen.) A report giving a synopsis of answers to questions sent to electric plants in Germany and Austria. 2000 w. Elektrotech Zeitschr—May 7, 1903. No. 55461 B.

We supply copies of these articles. See page 638.

Mechanical Applications.

The Mechanical Application of Electricity. W. B. Smith Whaley. Abstract of a lecture before Sibley College. Describing and illustrating the great progress made in the development of the application of electricity to the mechanic arts. 1800 w. Sib Jour of Engng—May, 1903. No. 55189 C.

Prospecting.

Electric Ore-Finding System. Edward Skewes. A discussion of the Daft and Williams electrical prospecting system. Thinks the system has possibilities, but at present its claims are "not proven." 3000 w. Eng & Min Jour—May 23, 1903. No. 55348.

Spain.

Electrical Progress in Spain. Henry L. Geissel. A report of the slow but steady progress being made in the electrical development. 1600 w. Elec Wld & Engr—May 2, 1903. No. 55078.

Stray Currents.

Regulations for the Protection of Metallic Pipes Against Stray Currents from Electric Railways (Leitsätze Betreffend den Schutz Metallischer Rohrleitungen Gegen Erdströme Elektrischer Bahnen). Regulations proposed by a Committee of the Verband Deutscher Elektrotechniker. 1500 w. Elektrotech Zeitschr—May 14, 1903. No. 55466 B.

GAS WORKS ENGINEERING

Alcohol Incandescent Lamps.

Incandescent Lighting with Alcohol (L'Alcohol Industriel-Eclairage par Incandescence). M. Luc. An illustrated description of various alcohol lamps with incandescent mantels. 2500 w. Rev Technique—March 25, 1903. No. 55416 D.

Benzene.

The Determination of Benzene in Illuminating Gas. L. M. Dennis and J. G. O'Neill, in *Jour. Am. Chem. Soc.* Describes a series of experiments, discussing the results. 3200 w. Am Gas Lgt Jour—May 18, 1903. No. 55255.

Calorimetry.

Calorimetry. E. Fearon. Read at meeting of the Manchester and Dist. Jr. Gas Assn., England. Describes method of determining the calorific value of gas by means of a calorimeter. 2200 w. Am Gas Lgt Jour—May 18, 1903. No. 55254.

Car Lighting.

Incandescent Gas Lighting for Railway Cars (Eclairage des Voitures de Chemins de Fer au Moyen de l'Incandescence par le Gaz). H. Giraud and G. Mauclère. An illustrated account of successful experience in lighting cars of the Eastern Ry. of France by incandescent gas light, using various kinds of gas. 5000 w. Rev Gén des Chem de Fer—May, 1903. No. 55404 H.

Firing.

Some Remarks on Gaseous Firing. Arthur Valon. Discusses some points in connection with a paper recently read by Mr. Whyte bearing on this subject. 1400 w. Jour Gas Lgt—May 19, 1903. No. 55397 A.

Fuel Gas.

Recent Developments in the Use of Gas for Fuel. William H. Morse. An outline of the present status and future outlook of gas used for the development of power. 4000 w. Engr, U S A—May 15, 1903. No. 55236 C.

Gas-Burners.

The Law and Practice Relating to Test Gas Burners. States how the case of the standard test-burner stands in England, both in law and by usage. 3500 w. Jour Gas Lgt—May 19, 1903. No. 55396 A.

Gaseous Mixtures.

Heat Reactions of Gaseous Mixtures. Extracts from a paper by R. Forbes Carpenter and S. E. Linder, published in the *Journal of the Society of Chemical Industry*. Deals with the heat reactions, theoretically considered, of different gaseous mixtures. 2800 w. Jour Gas Lgt—May 12, 1903. No. 55310 A.

Heating.

Domestic Heating by Gas. Donald McDonald. Read before the Ohio Gas Lgt. Assn. Discusses price, use, fixtures, etc. General discussion follows. 9000 w. Am Gas Lgt Jour—May 4, 1903. No. 55041.

High Pressure.

Distributing Illuminating Gas at High Pressure. F. H. Shelton. Describes examples of high-pressure practice in America, showing the conditions for which it is particularly applicable and convenient. 1700 w. Cassier's Mag—May, 1903. No. 55179 B.

Leakage.

Excavations for Sewerage Purposes, and Unaccounted for Gas: An Experience. E. G. Smithard. Read before the East. Co's Gas Mgrs. Assn. An account of the damage done in King's Lynn, causing explosions, and of the legal settlement. General discussion. 5500 w. Gas Wld—April 25, 1903. No. 55006 A.

We supply copies of these articles. See page 638.

Mains.

Experiences with Cement Joints for Street Mains. B. F. Bullock. Gives the writer's experience in the use of cement joints. Prefers the lead joints. 1000 w. Am Gas Lgt Jour—May 25, 1903. No. 55339.

Mantles.

Testing the Strength of Mantles. Abstract of a paper by M. Syssoyeff before the Soc. Tech. du Gaz en France, describing an appliance for measuring the strength of gas-mantles. 1100 w. Jour Gas Lgt—May 19, 1903. No. 55500 A..

Oil-Gas.

Gas Making with Crude Oil in California. Information as to the use of crude oil in various gas-works in California, and the apparatus used. 1200 w. Jour Gas Lgt —April 28, 1903. No. 55120 A.

Photometry.

Relation Between French and German Methods of Photometry. A. Lecomte. Abstract translation of a paper read before the Société Technique du Gaz en France. An explanation of the methods used with discussion of tests made on the two photometers. Also editorial. 1800 w. Jour Gas Lgt—May 19, 1903. No. 55398 A.

Pyrogas.

The Suppression of Smoke and the Utilization of its Constituents (La Suppression Radicale de la Fumée et la Récupération de ses Eléments). E. Guarini. An illustrated description of M. Tobiansky d'Altoff's system in which he enriches the products of combustion, including smoke, with hydrocarbons, and uses the resulting gas for lighting, heating and power. 3500 w. Rev Technique—May 10, 1903. No. 55427 D.

Retort Charging.

The New Parisian Retort Charging-Machine and Discharging-Ram. Illustrated detailed descriptions of these machines and their operation, with comments and general information. 6500 w. Jour Gas Lgt—May 19, 1903. No. 55395 A.

Retort Stoking by Electricity. Particulars from a description appearing in the *Bulletin Technologique* of the Sarrosin system for charging and drawing retorts. Ill. 2500 w. Jour Gas Lgt—May 12, 1903. No. 55309 A.

Revivification.

Revivification in Situ, and Stopped Ascension-Pipes. A summary of interesting observations communicated by Herr Burgemeister to the *Journal für Gasbeleuchtung*. Describes a simple and economical method of supplying air for the revivification of the fouled oxide in purifiers. 1500 w. Jour Gas Lgt—May 5, 1903. No. 55262 A.

Secondary Air Heating.

Is the Zigzag Flue Necessary for Heating Secondary Air? J. Whyte. Read before the North of England Gas Mgrs. Assn. Gives results of experiments made. General discussion follows. Ill. 3800 w. Jour Gas Lgt—April 28, 1903. No. 55121 A.

Water Gas.

The Dellwick-Fleischer Process of Carburetting Water Gas by Passing It Into Retorts. Abstract translation of a paper read by M. Lecomte before the Soc. Tech. du Gaz en France. Descriptive. 2500 w. Jour Gas Lgt—May 19, 1903. Serial. 1st part. No. 55399 A.

Blue Water Gas and Its Enrichment by the Peebles Oil Gas Process. E. J. Brockway. Read before the East. Co's. Gas Mgrs. Assn. An account of writer's experience with a combination of a Dellwick plant for making blue water gas, with the Peebles process as an enricher. 7500 w. Gas Wld—April 25, 1903. No. 55007 A.

Utilizing Water Gas in the Production of Illuminating and Heating Gases. William Young. An account of personal experience and the results obtained; also gives extracts from a patent relating to improvements in the manufacture of illuminating gas. Ill. 5500 w. Jour Gas Lgt —May 5, 1903. No. 55261 A.

INDUSTRIAL ECONOMY

Accounting.

See Civil Engineering, Municipal; Electrical Engineering, Generating Stations; and Railway Engineering, Miscellany.

American Competition.

The American Peril and the Electrical Industry (Die Amerikanische Gefahr und die Elektrotechnische Industrie). Emil Honigmann. A discussion of the danger of American competition in Europe, particularly in the electrical industries, apropos of an article by H. L. Geissel in the *Electrical World and Engineer*. Statistical tables. 5000 w. Zeitschr f Elektrtechnik—March 22, 1903. No. 55468 D.

Carnegie Address.

Andrew Carnegie's Presidential Address to the Iron and Steel Institute. Extracts from the address in London, referring to the relations of capital and labor. 5800 w. Ir Age—May 7, 1903. No. 55081.

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Consolidations.

See Electrical Engineering, Generating Stations.

Depreciation.

Sinking Fund Charges. W. H. Booth. A discussion of the best method of dealing with depreciation of a plant and buildings, and related matters. 3300 w. Tram & Ry Wld—April 9, 1903. No. 55018 B.

Education.

The Education of Engineers in America, Germany, and Switzerland. W. E. Dalby. Gives facts in connection with the training of engineers in the countries named as a basis for a discussion as to what course of training is best. 5000 w. Inst of Mech Engrs—April 24, 1903. No. 55165 D.

The Training of Engineers. Prof. Robert H. Smith. A discussion of the opportunities for scientific engineering education in Britain, noting the chief difficulties and defects of the present system. 4200 w. Engr, Lond—May 8, 1903. No. 55283 A.

Manchester Municipal School of Technology. From a paper by John T. Nicholsen before the Manchester Assn. of Engrs. Describes the steam engine laboratory in the present article. Ill. 2200 w. Mech Engr—May 9, 1903. Serial. 1st part. No. 55272 A.

See also Railway Engineering, Miscellany.

Employment.

The Employment Department of Employers' Association Work. J. C. Hobart. Address at the special convention of representatives of local employers' associations, held in Cincinnati under the auspices of the Nat. Metal Trades Assn. Considers the unions, the course of action for this association, etc. 4000 w. Ir Age—May 28, 1903. No. 55502.

Everett-Moore Syndicate.

The Winding Up of the Everett-Moore Syndicate. An outline of this syndicate, which gained control of the most remarkable groups of electric railway properties and independent telephone system, and of its downfall. 4500 w. St Ry Jour—May 2, 1903. No. 55099 D.

Foremen.

The Ideal Foreman. William Lodge. Address before the convention of local employers' associations at Cincinnati. Considers the requirements of a successful foreman, and gives suggestions. 8000 w. Ir Age—May 28, 1903. No. 55503.

Forestry.

See Civil Engineering, Materials.

Free Trade and Protection.

Free Trade and Protection (Freihandel und Schutzzoll). Karl Wittgenstein. An address giving a general discussion of the subject and the economic conditions of different countries. 8000 w. Zeitschd d Oesterr Ing u Arch Ver—March 20, 1903. No. 55476 B.

Industrial Efficiency.

The Promotion of Industrial Efficiency and National Prosperity. John B. C. Kershaw. A discussion of methods for bringing employers and employees into closer accord. This number gives brief descriptions of the plans in use at a large number of successful works in England, America, and on the Continent. 5500 w. The Engineering Magazine—June, 1903. No. 55494 B.

Irish Bogs.

A Future for Irish Bogs. R. H. Sankey. Gives information of the nature, extent and calorific value of the bogs of Ireland, and describes a plan of utilizing them for the generation of electrical energy which can be transmitted and made available at an extremely low price. 3000 w. Nineteenth Cent—May, 1903. No. 55260 D.

Iron and Steel.

See Mining and Metallurgy, Iron and Steel.

Municipal Trading.

Municipal Trading. Robert P. Porter. The views of an advocate of private ownership for all public utilities. Compares European and American methods and results. 3500 w. Munic Jour & Engr—May, 1903. Serial. 1st part. No. 55038 C.

Municipal Socialism: Latest Development in Great Britain. Reprint of an article from the Liverpool *Daily Post*, giving a report of the development of "municipal trading" in Great Britain. 2000 w. U S Cons Repts, No. 1638—May 5, 1903. No. 55166 D.

Organization.

The Organization of Manufacturing Industries. Extracts from the presidential address of Andrew Carnegie at the annual meeting of the Iron & Steel Inst. 4000 w. Eng News—May 14, 1903. No. 55220.

Purchase.

Purchase by the Organized Factory. Horace L. Arnold. A concise description of a practical system, in regular use, for ordering supplies into the factory, checking their receipt and every issue by the stores keeper, and safeguarding the payment of every invoice. The system is simple and almost automatic. Illustrated. 3000 w. The Engineering Magazine—June, 1903. No. 55498 B.

Records.

A Work in Progress Record. Kenneth Falconer. Gives forms used by the writer to furnish a history of each productive order. 1000 w. Am Mach—May 28, 1903. No. 55510.

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Research Institution.

Institution for Scientific Research (La Caisse des Recherches Scientifiques). Louis Rachou. An account of an institution founded and partly supported by the French government for promoting research work in medical, natural and physical science. 2500 w. Génie Civil—April 18, 1903. No. 54893 D.

Workmen's Dwellings.

Cheap Dwellings in France and Other Countries (Les Habitations à Bon Marché en France et à l'Etranger). E. Cacheux. A review of the question of low-priced dwellings for workmen, and an account of the operation of recent French laws. 1 plate. 5500 w. Mem Soc Ing Civils de France—March, 1903. No. 55409 C.

MARINE AND NAVAL ENGINEERING

Boilers.

See Mechanical Engineering, Steam Engineering.

Construction.

Some Points in the Construction of Large Steel Steamers and the Rivetting of Lapped Butts. Archibald Hogg. Read before the N.-E. Coast Inst. of Engrs. & Shipbuilders. The object of the paper is to call attention to the structural strength of large and full-formed steamers, and to suggest a new principle of lap butt rivetting. 2500 w. Engrs' Gaz—May, 1903. No. 55188 A.

Dredges.

See Civil Engineering, Canals, Rivers and Harbors.

Gasoline Fishing Boats.

Gasoline Engines for Fishing Boats (De l'Emploi des Moteurs à Pétrole à Bord des Bateaux de Pêche). J. Pérard. An illustrated account of the use of gasoline engines for propelling fishing vessels. 4000 w. Mem Soc Ing Civils de France—March, 1903. No. 55411 G.

Kaiser Wilhelm II.

The Latest Atlantic Liner, "Kaiser Wilhelm II." Brief illustrated description of this recently completed vessel, notable for her great size and power. 700 w. Sci Am—May 2, 1903. No. 55044.

Mammoth Ocean Greyhound. Illustrations and brief description of the Kaiser Wilhelm II, the latest German built trans-Atlantic express steamer. 700 w. Naut Gaz—April 30, 1903. No. 55040.

Lightships.

The New Lightships of the Coast of France. Translated from *La Nature*. Illustrations with brief descriptions. 1200 w. Sci Am Sup—May 23, 1903. No. 55317.

Minnesota.

Steamship Minnesota, of the Great Northern Steamship Company, Built by the Eastern Shipbuilding Company. Illustrated description of interesting features of construction and equipment of this mammoth ship. 8800 w. Marine Engng—May, 1903. No. 55046 C.

Giant Ships for Our Oriental Trade. F. N. Stacy. An interesting illustrated article describing the "Minnesota" and "Dakota." 2800 w. Rev of Revs—May, 1903. No. 55152 C.

Monitors.

A Comparison of the Trials of the New Monitors of the United States Navy. A summary from detailed reports of the four monitors recently authorized by Congress. The results are a valuable contribution to the subject of propeller design. 900 w. Marine Engng—May, 1903. No. 55050 C.

Propellers.

Plane Sections of the Blades of Screw Propellers (Le Sezioni Piane delle Pale d'Elica). A. Scribanti. A mathematical discussion of screw propellers, with diagrams and tables. 800 w. Rivista Marittima—March, 1903. No. 55491 H.

Railway Ferries.

Railway Trains on Ferries. Archibald S. Hurd. Describes and illustrates the ferry systems of Denmark, America, and other countries and discusses the use of such ferries across the English Channel. 4000 w. Cassier's Mag—May, 1903. No. 55181 B.

Reconstruction.

The Reconstructed New York. An interesting illustrated account of the work of bringing this well-known vessel up to the latest advances in marine engineering, and naval architecture, describing new features introduces. 1800 w. Marine Engng—May, 1903. No. 55051 C.

Refrigerated Cargoes.

Marine Installations for the Carriage of Refrigerated Cargoes. R. Balfour. Read before the Inst. of Nav. Archts. Describes the three systems of refrigeration most used, and discusses the construction of vessels best adapted, the design and arrangement of the holds in which the frozen cargo is carried. Ill. 6000 w. Engr, Lond—April 24, 1903. No. 55029 A.

Resistance.

On the Reduction of Wave-Making Resistance by a New Method. A letter from Walter Child, offering suggestions of a

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new method of reducing the wave-making resistance of vessels. 2800 w. Engng—May 1, 1903. No. 55202 A.

The Influence of Depth of Water on the Resistance of Ships. Charles P. Paulding. A study of the limiting economical speed of vessels in shallow water, and the determination of the least permissible depth for the contract trial of a given vessel required to make a given speed. 2000 w. Marine Engng—May, 1903. No. 55047 C.

Ship Design.

An Investigation of the Best Relations of the Depth and Draft of a Merchant Vessel to Its Beam (Ricerca dei Rapporti piu Convenienti dell' Altezza e dell' Immersione alla Larghezza di un Bastimento Mercantile). Ettore Mengoli. A discussion, partly mathematical, of the relations between the dimensions of ships, to secure minimum weight and resistance. 1200 w. Rivista Marittima—Feb., 1903. No. 55-488 H.

Trim.

A Special Trim Calculation. B. A. Sinn. Gives calculations made necessary by the arrangement of the interior. 800 w. Marine Engng—May, 1903. No. 55049 C.

Wrecking Work.

Wrecking Work of the Boston Towboat Company. Winthrop L. Marvin. An illustrated account of the work, with descriptions of the methods used, and reports of some of the vessels saved, with related matter of interest. 3300 w. Marine Engng—May, 1903. No. 55048 C.

Yachts.

The American Steam Yachts. W. P. Stephens. An interesting illustrated article reviewing its evolution and discussing its future development. 4500 w. Rudder—May, 1903. No. 55066 C.

The "Reliance" Under Sail. Gives views taken on the first trial of the new yacht, with descriptive notes. 1100 w. Sci Am—May 9, 1903. No. 55127.

MECHANICAL ENGINEERING

AUTOMOBILES.

Agricultural Motor.

The Ivel Agricultural Motor. Herbert C. Fyfe. Brief illustrated description of a motor constructed to draw reapers, plows, mowers, wagons, etc. Designed chiefly for the use of farmers. 800 w. Sci Am—May 30, 1903. No. 55521.

Darracq Vehicle.

The Light Darracq Vehicle (Le Voiture Légère Darracq). An illustrated description of a modern gasoline vehicle of the Darracq type. 700 w. Rev Technique—May 10, 1903. No. 55426 D.

Electric Carriages.

A Novel Electric Carriage. Illustrated description of a vehicle aiming at long wheel base, and low center of gravity. 900 w. Motor Car Jour—April 25, 1903. No. 55000 A.

The Waverley Electromobiles. Illustrates and describes a number of these light electric vehicles. 3200 w. Auto Jour—April 25, 1903. No. 55001 A.

Gordon-Bennett Race.

American Champions for the Gordon-Bennett Race. Hugh Dolnar. An illustrated account of the Long Island eliminating tests. 2800 w. Autocar—May 2, 1903. No. 55199 A.

The American Gordon-Bennett Champions. Hugh Dolnar. An illustrated article giving details of the vehicles chosen and brief account of the final trials. 2000 w. Autocar—May 9, 1903. No. 55266 A.

The Eliminating Trials. An illustrated account of the trials in England for the selection of cars for the Gordon-Bennett races. 1300 w. Autocar—May 2, 1903. No. 55198 A.

Winton Tries His Cup Racer. An illustrated description of the "Bullet II," with account of the trial. 1800 w. Automobile—May 16, 1903. No. 55238.

Horse-Power.

Horse Power at Various Speeds. Gives curves for seven weights of cars, showing power wanted for driving each at speeds above twelve miles per hour on the level and on grades. 700 w. Automobile—May 9, 1903. No. 55135.

Ignition.

The Eisemann and Bosch Systems of Electric Ignition. Drawings showing the general arrangement and principles of both these systems, with descriptive notes. 1500 w. Auto Jour—May 9, 1903. No. 55268 A.

Mercedes Car.

The 60 h. p. Mercedes. An illustrated article describing details of these cars. 1000 w. Autocar—May 16, 1903. Serial. 1st part. No. 55358 A.

Petrol Cars.

The Crouan Petrol Car. An illustrated article describing the recent cars of this French firm. 2000 w. Auto Jour—May 16, 1903. Serial. 1st part. No. 55359 A.

The Rochet-Schneider 16-20-H. P. Petrol Car—1903 Type. Illustrated detailed

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description. 3300 w. Auto Jour—May 9, 1903. No. 55267 A.

The "Spyker" Petrol Car. Illustrates and describes a car exhibited at the recent exhibition at Agricultural Hall. These cars were made in Holland. 800 w. Motor Car Jour—May 9, 1903. No. 55269 A.

Racing Cars.

French Racing Motor Cars. Remarks on the effect of the accident at the recent meeting at Nice on the future of motor car racing, with discussion of the benefits from the races, and illustrated descriptions of the more remarkable of the cars entered. 2400 w. Engr, Lond—April 24, 1903. No. 55027 A.

Railway Vehicles.

Gasoline Vehicles for Railways (Quadricycle et Wagonette à Pétrole pour la Circulation sur les Lignes de Chemins de Fer). L. Pierre-Guédon. An illustrated description of a quadricycle and a wagonette with petrol motors, for regular railway service. 800 w. Génie Civil—April 18, 1903. No. 54892 D.

Serpollet.

The Serpollet Steam Automobile. Begins an illustrated detailed description. 800 w. Sci Am Sup—May 16, 1903. Serial. 1st part. No. 55247.

Starting Motors.

The Starting of Gasoline Engines (Les Moteurs à Pétrole Mise en Marche). M. Réperti. An illustrated account of starting devices for internal-combustion motors and methods of getting the latter going. 2000 w. Rev Technique—April 25, 1903. No. 55422 D.

Torbensen Gear.

The Torbensen Transmission System. Herbert L. Towle. Illustrated description of the running gear designed by V. V. Torbensen. 2000 w. Automobile—May 9, 1903. No. 55136.

Tractive Resistance.

The Tractive Power of Automobiles (Automobilisme: L'Effort de Traction dans les Voitures Automobiles). A discussion of the tractive power and resistance of automobiles on various pavements, with diagrams and tables. 2500 w. Rev Technique—March 25, 1903. No. 55417 D.

HYDRAULICS.

Pumps.

See Mechanical Engineering, Special Motors.

Pump Valves.

The Valve Motions in Reciprocating Pumps (Etude du Mouvement des Clapets dans les Pompes à Mouvement Alternatif). C. Enquehard. A study of the action of the valves of high-speed reciprocating pumps, with diagrams. 600 w. Rev de Mécanique—April 30, 1903. No. 55403 E + F.

Turbine Tests.

Brake Tests of a Radial Turbine (Bremsversuche an einer Radialturbine, Gebaut von der Maschinenfabrik Briegleb, Hansen & Co., in Gotha). Prof. Pfarr. An illustrated account of a test of a German turbine and comparison with test of a "New American" turbine of the same size and using about the same volume of water. Diagrams and tables. 700 w. Zeitschr d Ver Deutscher Ing—May 2, 1903. No. 55449 D.

A Prony Brake Test of a Horizontal Turbine for the Bates Mfg. Co., Lewiston, Me. William O. Webber. An illustrated account of tests made to determine if a pair of horizontal turbine waterwheels fulfilled a guaranteed performance of 688 brake horse-power at 223 revolutions per minute and 27 ft. of head. 800 w. Eng News—April 30, 1903. No. 55088.

MACHINE WORKS AND FOUNDRIES.

Axles.

Hollow Pressed Axles. Camille Mercader. Read at meeting of the Iron and Steel Inst. Gives the method proposed by the writer, reporting experiments, tests, etc., and describing the hydraulic axle forging machine. Gives advantages claimed. Ill. 4200 w. Ir Age—May 7 and 14, 1903. Serial. 2 parts. No. 55079.

Hollow Pressed Axles. Camille Mercader. Extracts from a paper read at meeting of the Iron and Steel Inst. Describes the method proposed by the writer for making by pressure, axles having varying diameters. Also reports experiments made regarding material for the punches, and other details of the work. Ill. 2500 w. Can Engr—May, 1903. No. 55036.

Castings.

Common Methods of Altering Old Patterns. An illustrated article suggesting changes that may be made oftentimes in patterns so that they may serve for different castings and so lessen expense. 1500 w. Prac Engr—April 24, 1903. No. 55003 A.

Melting Steel with Cast Iron. R. P. Cunningham. Read before the New England Found. Assn. Describes the method of charging the cupola, and the proper management to give castings of a required strength. 1200 w. Foundry—May, 1903. No. 55173.

Chucks.

Bench Lathe Chucks and Attachments for Operating Them. Jos. M. Stabel. Illustrates and describes several chucks, and the devices for operating them. 900 w. Am Mach—May 7, 1903. No. 55104.

We supply copies of these articles. See page 638.

Coining.

Coining Machinery in Chinese Mints. Oberlin Smith and Henry A. Janvier. An account of the installation of plants for producing certain issues of coins for the Chinese Government. Gives information in regard to the customs of the country, describing journey into the interior. Ill. 3400 w. Cassier's Mag—May, 1903. No. 55176 B.

Core Boxes.

Core Boxes for Globe Valves. Robert Wagner. Illustrates and describes a method in which only two core boxes are used and two cores give one complete valve. 400 w. Foundry—May, 1903. No. 55174.

Cores.

Core-Making Machine. Illustrated description of a machine intended for producing complicated cores. 800 w. Engng—April 24, 1903. No. 55024 A.

Dies.

A New Opening Die. Illustrates a new die intended for turret lathe work and possessing novel features. 1100 w. Am Mach—May 7, 1903. No. 55101.

Drilling.

Experiments upon the Work of Machine Tools—Drill Shavings (Expériences sur le Travail des Machines-Outils—Copeaux de Forage). M. Codron. A profusely illustrated study of the shavings cut by different kinds of drills from various metals, forming a continuation of the author's investigations on machine tools. 5000 w. Bull Soc d'Encour—April 30, 1903. No. 55402 G.

A Large Drilling Machine. General view and brief description of a fine machine recently made in England. 500 w. Engr, Lond—May 8, 1903. No. 55284 A.

Foundry Management.

Foundry Management in the New Century. VII. The Qualities and Training of the Foundry Manager. Robert Buchanan. Concluding a series by a very sound and interesting statement of existing labor conditions and tendencies which the foundry manager must meet and control, and the policy which will prove successful. 2500 w. The Engineering Magazine—June, 1903. No. 55499 B.

Gaggers.

Gaggers. James A. Murphy. On the usefulness of gaggers in the foundry, with an illustrated description of a machine for making them. 1200 w. Foundry—May, 1903. No. 55172.

Grinding.

Some More Points About Grinding. C. H. Norton. Discusses points brought up by Tecumseh Swift and F. Thornley, and gives personal experiences. 4200 w. Am Mach—May 7, 1903. No. 55100.

Hunt Methods.

Hunt's Measurements and Drawings. John Randol. The first of a series of illustrated articles describing the method of making measurements in machine work used by the C. W. Hunt Company. 2800 w. Am Mach—May 21, 1903. Serial. 1st part. No. 55299.

Lathe.

Motor-Driven Shafting Lathe. Illustrations and description of a recently designed lathe having points of interest. It is driven by an 18 h. p. variable speed motor. 800 w. Am Mach—May 28, 1903. No. 55509.

Machine Design.

Elements of Successful Machine Design. Ralph Scott. Considers various factors with respect to their relation to design, and gives rules to be borne in mind by designers. 3000 w. Elec, N. Y.—May 20, 1903. No. 55297.

Machine Tools.

Modern American Machine Tools. Charles H. Benjamin. A discussion of the problem from the standpoint of a designer, considering the architectural and utilitarian sides. Ill. 2500 w. Cassier's Mag—May, 1903. No. 55177 B.

Milling Keys.

Milling Keys. Illustrates and describes special tools constructed in such a way that by making a few changes the tool will answer for several sizes. 1400 w. Am Mach—May 7, 1903. No. 55103.

Notching Machine.

A Machine for Cutting Notches in Railroad Ties (Machine à Saboter les Traverses de Chemins de Fer). An illustrated description of a machine for quickly cutting notches in wooden cross ties for the rails to rest in. 1 plate. 1500 w. Génie Civil—March 21, 1903. No. 54883 D.

Order System.

An Order System for Foundries. J. Byron Henry. Outlines methods for keeping record of foundry orders in shops with a large output that make a specialty of jobbing orders. 1200 w. Foundry—May, 1903. No. 55175.

Patterns.

Numbering and Storing Patterns. S. A. Worcester. Considers the arrangement of shelves, and describes the system recommended. 1000 w. Am Mach—April 30, 1903. No. 54987.

Printing-Press Factory.

The Printing-Press Factory of Koenig and Bauer, near Würzburg, Germany (Die Schnellpressenfabrik von Koenig & Bauer in Kloster Oberzell bei Würzburg).

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An illustrated description of the new works of this old firm, which has manufactured high-speed printing presses for nearly 100 years. 5500 w. Zeitschr d Ver Deutscher Ing—April 18, 1903. No. 55444 D.

Racks.

Cutting Racks—Approximate Sizing of Gear Blanks. Illustrates and describes the solution of the problem as worked out by the Cincinnati Planer Company. 1200 w. Am Mach—May 7, 1903. No. 55102.

Reamers.

The Construction and Working of Machine Reamers and Reaming Heads. E. Bruce Ball. The present article gives illustrated descriptions of various types of reamers and their work, explaining their economy and reliability. 3500 w. Engng—May 8, 1903. Serial. 1st part. No. 55280 A.

Rivets.

Concerning Rivet Heads. Gives a table for the various diameters of rivets, showing the proper projections through the plates to be joined, illustrating its use by examples. 1500 w. Locomotive—Feb., 1903. No. 55167.

Sheet-Metal Work.

Manufacturing Armature Disks and Segments. Joseph V. Woodworth. Illustrated description of dies, presses and special machinery for this work. 1800 w. Mach, N. Y.—May, 1903. No. 55106 C.

Swaging.

Swaging Machines and the Cold Swaging Process. Illustrates and describes several swaging machines and their work, and discusses uses made of this process. 2500 w. Mach, N. Y.—May, 1903. No. 55105 C.

Tools.

Tools and Gauges in the Modern Shop. H. F. L. Orcutt. Abstract of a paper read before the Inst. of Engrs. and Shipbuilders in Scotland. Considers important items to the successful introduction of improved equipment in shops. 5000 w. Mech Engr—April 25, 1903. No. 55005 A.

Tool Steels.

High-Speed Tool Steels. William Lodge. Read at recent meeting of Cincinnati Machine Tool Mfrs. Gives suggestions for the use of high-speed steels on cast iron, and the general operation of these tools. 1400 w. Ir Trd Rev—May 21, 1903. No. 55302.

High-Speed Metal Cutting. Oberlin Smith. Discusses the recent improvements in tool steel, and the consequent improvement needed in machine-tool design; considers the planer problem. 2000 w. Am Mach—May 21, 1903. No. 55301.

MATERIALS OF CONSTRUCTION.

Alcohol.

Alcohol for Industrial Purposes. Reviews the results accomplished in the use of alcohol for heat, light and power. 2000 w. Mach, N. Y.—May, 1903. No. 55107 C.

Decay of Metals.

The Decay of Metals. J. T. Milton and W. J. Larke. Abstract of a paper read before the Inst. of Civ. Engrs. Discusses cases of decay and the probable causes. 1500 w. Sci Am Sup—May 16, 1903. No. 55245.

Wire Rope.

The Invention, Properties and Future of Wire Rope (Das Drahtseil, seine Erfindung, Eigenschaften und Zukunft). Prof. O. Hoppe. A historical and descriptive discussion of wire rope and its uses. 5500 w. Glückauf—April 4, 1903. No. 55438 D.

MEASUREMENT.

Bending Moments.

Bending Moments Not in the Same Plane. H. F. Moore. Presents a phase of a problem in machine design frequently encountered, describing method used. Ill. 1000 w. Sib Jour of Engng—May, 1903. No. 55191 C.

Copper Tests.

Breaking Tests with Long Continued Heating. The Behavior of Copper (Der Warmzerreissversuch von Langer Dauer. Das Verhalten von Kupfer). Prof. R. Stribeck. A well illustrated account of tension tests of copper bars subjected to high temperatures for long periods in an electric oven. 4000 w. Zeitschr d Ver Deutscher Ing—April 18, 1903. No. 55445 D.

Expansion.

The Expansion of Steel at High Temperatures (Recherches sur la Dilatation des Aciers aux Températures Elevées). G. Charpy and L. Grenet. An illustrated account of elaborate researches on the expansion and other properties of steel at high temperatures, particularly about 700° C., the "recalescence" point. Diagrams and tables. 8000 w. Bull Soc d'Encour—April 30, 1903. No. 55401 G.

Friction Tests.

Coefficients of Friction between Wood and Iron (Reibungs-Koeffizienten zwischen Holz und Eisen). Prof. L. Klein. An account of friction tests made with iron and various kinds of wood, with particular reference to brakes for mine hoisting apparatus. 2 plates. 2500 w. Glückauf—April 25, 1903. No. 55441 D.

Metric System.

The Metric System in the Machine

We supply copies of these articles. See page 638.

Shop. Views of August Hoffmann on the relative merits of inch measurements and the metric system, favoring the latter. 800 w. Am Mach—May 14, 1903. No. 55234.

Standards.

Weights and Measures. Prof. S. W. Stratton. Reviews what has been done by the U. S. government in regard to fixing standards of weights and measures, describing the functions of the National Bureau of Standards and the work. General discussion. 6500 w. Pro Engrs' Soc of W Penn—March, 1903. No. 55290 D.

Steel Tests.

Soft vs. Hard Steel as a Structural Material (Weiches und Hartes Flusseisen als Konstructionsmaterial). F. R. Eichhoff. An account of an elaborate series of tests which were made at the Krupp Works to determine the relative merits of soft steel and hard steel as structural materials. Tables. 5 plates. 5000 w. Stahl u Eisen—April 15, 1903. No. 55430 D.

POWER AND TRANSMISSION.

Air Compressors.

Air Compressors for Mining Operations (Luftkompressoren im Zechenbetriebe). An account of tests of many air compressors made by the Boiler Inspection Association of the Mines in the Dortmund District, Germany, with many illustrations and diagrams. 6 plates. 8000 w. Glückauf—March 28, 1903. No. 55437 D.

See also Mining and Metallurgy, Coal and Coke.

Belting.

Hints on Leather Belting. W. H. Kritzer. Gives suggestions for arrangement and location of belts, and rules for finding length of belt needed, horse-power, speed, and width. Ill. 1200 w. Min & Sci Pr—April 25, 1903. No. 55045.

Cranes.

Modern Crane Construction. George William Rushworth. An illustrated article describing various types. 4500 w. Feilden's Mag—May, 1903. Serial. 1st part. No. 55378 B.

Flywheels.

The Design of Flywheels. A. Kemp. Discusses things that must be taken into consideration in the designing of flywheels and gives method of plotting diagrams. 1600 w. Feilden's Mag—May, 1903. No. 55375 B.

Ore-Carrying.

The Handling and Storing of Iron Ore. Charles Piez. Considers how a great reduction in cost has been brought about by labor-saving appliances. General discussion. 4000 w. Pro Engrs Club of Phila—April, 1903. No. 55162 D.

SPECIAL MOTORS.

Compound Engines.

Some Remarks on the Compound Explosion Engine. E. Butler. Gives an illustrated description of an engine designed by the writer, demonstrating the behavior of the explosive gases. 1600 w. Feilden's Mag—May, 1903. No. 55377 B.

Crude Oil.

The Application of Crude Oil to Gas Engines. Frank H. Bates. A study of the methods of gasification of crude oil for the gas engine. Ill. 7700 w. Jour of Elec—May, 1903. No. 55507 C.

Dunlop Engine.

Dunlop's Reversible Self-Starting Internal-Combustion Engines. The illustrations show a launch engine. The arrangement and operation are fully described. 2500 w. Mech Engr—May 9, 1903. No. 55270 A.

Explosion Pressures.

Investigations of the Pressures in Closed Vessels Due to the Explosion of Hydrogen and of Carbonic Oxide (Untersuchungen über die Drücke, welche bei Explosionen von Wasserstoff und Kohlenoxyd in Geschlossenen Gefässen Auftreten). Dr. Arnold Langen. An illustrated account of experiments on the thermodynamic phenomena with explosive mixtures of gases, such as are used in internal-combustion motors. Tables and diagrams. 4000 w. Zeitschr d Ver Deutscher Ing—May 2, 1903. No. 55448 D.

Gas Engine.

A Combined Gas and Steam Engine (Moteur à Gaz et à Récupération des Calories Actuellement Perdues). Jules Garnier. An illustrated description of an internal-combustion engine, in which the cooling water is injected into the cylinder and there vaporized, the steam performing useful work on the piston. 2800 w. Mem Soc Ing Civils de France—March, 1903. No. 55407 G.

Diagnosing Gas Engine Ills. An outline of the principles which govern the action of these motors. The present article discusses the subject of ignition. 1600 w. Automobile—May 23, 1903. Serial. 1st part. No. 55337.

Recent Developments in Gas Engines. A. V. Coster. Considers the great changes due to the manufacture of cheap gas, and changes in the design of gas engines. Particularly considering large gas engines of 500 brake h. p. and upwards. Ill. 1500 w. Prac Engr—April 24, 1903. Serial. 1st part. No. 55004 A.

Gasoline Engines.

See Marine and Naval Engineering.

We supply copies of these articles. See page 638.

Gas Power.

The Economical Generation and Distribution of Power in Large Works. A. Rollason. Read before the W. of Scotland Iron and Steel Inst. Gives facts aiming to show that gas power is the most economical for all purposes. 3000 w. Ir & Coal Trds Rev—April 24, 1903. No. 55021 A.

Ignition.

See Mechanical Engineering, Automobiles.

Kerosene Engine.

A Simple Kerosene Engine. Illustrated description of a new type having the merit of simplicity. 1400 w. Sci Am—May 23, 1903. No. 55312.

Pumping Station.

A Gas Engine Pumping Station. An illustrated description of the plant of the Pittsburg Glass Company, at Ford City, Pa. 1800 w. Eng Rec—May 23, 1903. No. 55355.

Rotary Engine.

The Primat Alternating Rotary Engine (Le Moteur Alterno-Rotatif Primat). An illustrated description of a rotary engine with four cylinders, which can be used as an internal-combustion engine, a steam or vapor engine, or a compressed-fluid engine. 1200 w. Rev Technique—May 10, 1903. No. 55425 D.

Starting Motors.

See Mechanical Engineering, Automobiles.

STEAM ENGINEERING.

Boiler Explosion.

An Interesting Boiler Explosion. A. H. Smith. An illustrated account of the explosion at the Republic Iron & Steel Co.'s plant in Toledo, Ohio, which was probably due to the leaving of a 6-in. valve closed after cleaning, and its sudden opening. 1000 w. Eng News—May 7, 1903. No. 55139.

Boilers.

The Construction of Seamless Boilers. G. Lentz. Illustrated description of the apparatus for producing the hollow-tubular bodies by the Ehrhardt hydraulic pressing process. 1600 w. Am Engr & R R Jour—May, 1903. No. 55075 C.

Circulation in Shell Boilers. William Thomson. Read before the Inst. of Mech. Engrs. Considers the circulation of all fluids connected with shell boilers, as well as the heat which goes to produce the final result. 5000 w. Naut Gaz—May 21, 1903. No. 55340.

The Boiler Problem in the Navy. Discusses the cause of the trouble in the "Maine," believing the injuries due to the type of boiler. General discussion of the water-tube boiler problem. 2500 w. Ir Age—May 7, 1903. No. 55080.

A Double Drum Boiler. A brief illustrated description of the Robb-Mumford boiler. 1000 w. Eng Rec—May 9, 1903. No. 55150.

The Choice of a Steam Boiler. C. E. Stromeyer. Abstract of a paper read before the Civ. & Mech. Engrs. Soc., England. A discussion of types, giving a tabulated comparison of boilers as regards evaporation per space occupied. 2000 w. Mech Engr—May 16, 1903. No. 55362 A.

Yarrow Boilers (Generatori di Vapore Yarrow). Bruzzone Attilio. An illustrated description of the Yarrow express boilers on the first class torpedo boat "Condore," and an account of experience with them. 8000 w. Rivista Marittima—Feb., 1903. No. 55487 H.

Boiler Scale.

Formation of Boiler Scale from Fresh Waters and Its Prevention. Dr. J. Ohly. Discusses methods of purifying the water before bringing it into the boiler. 1800 w. Min Rept—April 30, 1903. No. 55037.

Corliss Engine.

Corliss' First Compound Pumping Engine. An account of this engine as given in a recent paper by George R. Phillips, with illustrations. 600 w. Power—May, 1903. No. 55068 C.

Dinnendahl.

Franz Dinnendahl. A Steam Engine Centennial (Franz Dinnendahl. Ein Hundertjähriges Dampfmaschinen-Jubiläum). Conrad Matschoss. An illustrated biographical sketch of Franz Dinnendahl, about the first steam-engine builder in western Germany, and descriptions of his early pumping engines for mines. 6000 w. Zeitschr d Ver Deutscher Ing—April 25, 1903. No .55447 D.

Dusseldorf Exposition.

Steam Engines at the Düsseldorf Exposition (Les Machines à Vapeur à l'Exposition de Düsseldorf). P. F. Dujardin. An illustrated description of some steam engines and auxiliary apparatus exhibited at Düsseldorf, in 1902. 1 plate. 2200 w. Génie Civil—April 25, 1903. No. 54894 D.

Electric Plants.

Steam Practice in American Electric Light and Power Plants. George H. Barrus, George I. Rockwood, H. C. Meyer, Jr., and Charles W. Oliver. Articles by the above authors, dealing with boiler practice, piping, engines, etc. Ill. 9500 w. Am Elect'n—June, 1903. No. 55527.

American Steam Engines for Electric Light and Power Service. H. F. Schmidt. Illustrated descriptions of many modern types. 16500 w. Am Elect'n—June, 1903. No. 55528.

We supply copies of these articles. See page 638.

Epicycloidal Engine.

The Cooley Epicycloidal Steam Engine. Illustrates and describes a new type of rotary engine and the principle of its construction. 1400 w. Mach, N. Y.—May, 1903—No. 55108 C.

Feed Water.

Feed Water for Boilers (Ueber Kesselspeisewasser). Hr. Bracht. An account of feed waters, their impurities and methods of purification. 1500 w. Glückauf—March 14, 1903. No. 55436 D.

Water for Locomotive Boilers. William M. Jewell. Notes on the selection and application of water in a boiler, and related matter. 1500 w. R R Gaz—May 15, 1903. No. 55214.

Hoisting Engine.

The Steam Consumption of a Hoisting Engine at the Emscher Mine, in the Cologne District, Germany (Bestimmung des Dampfverbrauchs an der Fördermaschine auf Schacht Emscher des Kölner Bergwerks-Vereins). An account of a test made by the Boiler Inspection Association of the Mines in the Dortmund District, Germany, with diagrams. 1000 w. Glückauf—April 18, 1903. No. 55440 D.

Injected Water.

Temperature Tests of Injected Water. H. M. Wickhorst. An illustrated article describing tests made to determine whether the water fed into a locomotive by the injector, having greater specific gravity, does not flow to the bottom of the boiler. Also suggests two methods of getting a better mixture of injected water. 1500 w. Ry Age—May 22, 1903. No. 55342.

Oil Fuel.

Crude Oil as a Fuel. A. M. Hunt. Paper read before the California Miners' Assn., San Francisco, Nov., 1902. Facts from the writer's experience relating to the use, efficiency, cost, etc. Ill. 4500 w. Jour of Elec—May, 1903. No. 55508 C.

On the Use of Beaumont Oil as Fuel. Henry H. Humphrey. Discusses the advantages and disadvantages of oil fuel, and the questions relating to its use. 3800 w. Jour Assn of Engng Soc's—March, 1903. No. 55157 C.

Pipe Coverings.

Pipe Coverings. R. T. Strohm. Discusses in the order of their importance the special requirements of a good pipe covering. 2500 w. Am Elect'n—May, 1903. No. 55111.

Piston Rings.

Piston Rings of Steam Engines (Conditions d'Etablissement des Anneaux de Piston des Machines à Vapeur). E. Déthiollaz. An illustrated discussion of the pressures on, and proper dimensions of, piston rings to avoid unnecessary strains. 1300 w. Rev Technique—March 10, 1903. No. 55415 D.

Reheaters.

The Use of Reheaters in Compound Engines. Abstract of a paper by George H. Barrus, read before the New England Cotton Mfrs. Assn., giving valuable data based on tests by the author. 1700 w. Eng Rec—May 9, 1903. No. 55149.

Rotary Engine.

A Curious Rotary Engine. Joseph Riley. Photograph and sectional model with brief description. 1200 w. Engr, U S A—May 1, 1903. No. 55083 B.

Steam Turbines and Rotary Engines. Principally a description of the Hult rotary engine and its working. 2000 w. Am Mach—May 21, 1903. No. 55300.

The Hult Rotary Steam Engine. An illustrated description of the construction and working of a novel engine. 2000 w. Elec Rev, Lond—May 1, 1903. No. 55196 A.

Smoke Prevention.

See Gas Works Engineering; and Mechanical Engineering, Miscellany.

Steam Blows.

The Location of Steam Blows in Tandem Compound Locomotives. F. P. Roesch. Instructions, with illustrations showing sections through steam chests, valves, and cylinders with valves in various positions for testing. 700 w. Ry Mas Mech—May, 1903. No. 55065.

Steam Turbines.

Recent Steam Turbine Applications with Data of Performances. Hon. G. L. Parsons. Outlines the improvements made in the Parsons turbines, and illustrates and describes recent applications. 3000 w. Cassier's Mag—May, 1903. No. 55182 B.

Steam Turbines (Le Turbine a Vapore). Alberto Pacchioni. An illustrated historical and descriptive review of steam turbines. 11000 w. Rivista Marittima—March, 1903. No. 55490 H.

Superheated Steam.

Tests of a Belgian Engine Using Superheated Steam. Reports a series of tests made by Prof. M. Schroeter of Munich on a van den Kerchove engine. The object was to study the behavior of the engine with saturated and superheated steam under different conditions. Ill. 1600 w. Am Elect'n—May, 1903. No. 55110.

Valve Gear.

Valve Gear of the Porter-Allen Engine. Illustrated description. The special feature is the use of a link, actuated by a single eccentric and driving independently the steam and exhaust valves. 2300 w. Power—May, 1903. No. 55069 C.

We supply copies of these articles. See page 638.

Water in Steam.

Water in Steam. James Andrews. Read before the Glasgow Tech. Col. Sci Soc. Gives rules for calculating the rate of expansion, the dimensions of cylinders, mean pressure, etc., and discusses steam jackets, and means of securing economy in steam consumption in the present article. 2000 w. Mech Engr—May 16, 1903. Serial. 1st part. No. 55363 A.

MISCELLANY.

Aeronautics.

Aeronautics (L'Aéronautique). Jean de Villethiou. Various notes on aeronautics, with illustrations. Serial. 2 parts. 2000 w. Rev Technique—March 10 and 25, 1903. No. 55414 each D.

Aerial Progress. Describes the trials of M. M. Lebaudy's navigable balloon, and M. Santos Dumont's No. 9 airship. Both were very successful. Ill. of the latter. 1200 w. Auto Jour—May 16, 1903. No. 55360 A.

Air Buffers.

The Air Buffer. Ernest R. Briggs. Illustrates and describes the air buffer of the Willans engine, and discusses various applications. 2400 w. Am Mach—April 30, 1903. No. 54988.

Arithmograph.

The Arithmograph, a Calculating Machine (Sur un Calculateur, Mécanique Appelé Arithmographe). M. Troncet. An illustrated description of an apparatus which will perform mechanically all arithmetical operations. 400 w. Comptes Rendus—March 30, 1903. No. 54872 D.

Education.

See Industrial Economy.

Heating and Ventilation.

Ventilation and Heating in the New Government Building at San Francisco. Describes the system used in the San Francisco post-office and court-house building. The air is heated by hot water and supplied by plenum fans; the foul air being removed by exhaust fans. 2800 w. Eng Rec—May 2, 1903. No. 55119.

The Heating and Ventilating Plant of the New Swiss Parliament Buildings in Bern (Die Heizungs und Lüftungsanlagen des Neuen Schweizerischen Bundeshauses in Bern). A description, with plans and figures, of an extensive heating and ventilating system installed by Sulzer Brothers, of Winterthur, Switzerland. Serial. 2 parts. 4000 w. Schweiz Bauzeitung—March 21 and 28, 1903. No. 55483 each D.

Refrigerating Machine.

Efficiency Tests of Linde Ice Machines (Leistungsversuche an Linde-Maschinen). E. Brauer. An account of tests on Linde refrigerating machines at two German breweries. 1500 w. Zeitschr d Ver Deutscher Ing—May 9, 1903. No. 55451 D.

Refrigeration.

A Cold Storage Warehouse. An illustrated description of the conversion of a brewery in Rochester, N. Y., into a cold storage plant. The system of refrigeration makes use of a circulation of chilled air to the rooms to be cooled. 2000 w. Eng Rec—May 18, 1903. No. 55232.

The Necessary Apparatus for Mechanical Refrigeration. Oswald Gueth. A lecture delivered before the James Watt Assn., No. 7, N. A. S. E. An illustrated article discussing the apparatus used in ammonia compression plants, the diversity found, the different systems, and related subjects. 6300 w. Engr, U S A—May 1, 1903. No. 55082 B.

See also Marine and Naval Engineering.

Smoke.

Smoke and the Determination of its Density. Albert A. Cary. Abstract of a paper read before the New England Cotton Mfrs. Assn. Describes the production of coal gas, showing why soot is greasy and sticky, and the cause of smoke, in the present number. 3000 w. Elec Rev, N. Y.—May 23, 1903. Serial. 1st part. No. 55514.

Smoke and Gas.

The Effect of Smoke and Gas upon Vegetation. W. A. Buckhout. Considers the elements that cause injuries and the difficulties in determining their presence in many cases. 4800 w. Mines & Min—May, 1903. No. 55056 C.

Smoke Prevention.

Two Experiments in Smoke Preventing Furnaces. Illustrates and describes two devices for securing improved combustion in boiler furnaces. One the invention of J. B. Harris; the other of Robert L. Walker. 1900 w. Eng News—May 21, 1903. No. 55321.

The Wilskemp Smoke Consumer. Illustrated description of a recent English invention. 1000 w. Engr, Lond—May 8, 1903. No. 55286 A.

See also Gas Works Engineering.

Sugar Refinery.

The New Plant of the Sugar Works at Cambrai, France (Les Installations Nouvelles de la Sucrerie Centrale de Cambrai, à Escaudoeuvres). A well illustrated description of a beet-sugar refinery, equipped with modern machinery, including an electric plant. Serial. 2 parts. 1 plate. 5000 w. Génie Civil—April 18 and 25, 1903. No. 54891 each D.

We supply copies of these articles. See page 638.

Windmills.

The Royal Agricultural Society's Windmill Trials. An illustrated description of the mills and an account of the nature of these important trials. 11000 w. Engr, Lond—May 1, 1903. No. 55204 A.

Wind-Engines at the Royal Agricultural Society's Ground, Ealing. Illustrated descriptions of several types of engines sent in for competition for the series of trials of wind-engines for pumping. 3300 w. Engng—April 24, 1903. No. 55025 A.

MINING AND METALLURGY

COAL AND COKE.

Anthracite.

The Coal Industry of Pennsylvania. W. Frank M'Clure. Remarks on the rapid development during recent years, with information concerning the mines and methods. Ill. 2500 w. Sci Am—May 23, 1903. No. 55314.

Boiler Fuel.

Coal as a Boiler Fuel. E. B. Wilson. Discusses the comparative values of carbon and volatile matters for steam making, and the different causes of incomplete combustion. 1500 w. Mines & Min—May, 1903. No. 55063 C.

Coal Cutting.

Chain and Pick Coal Cutting Machines. An illustrated article comparing the two types from the standpoint of an advocate of chain machines. 2000 w. Min Rept—May 7, 1903. No. 55131.

Coal Washing.

A Modern Method of Coal Washing. C. A. Meissner. Read before the Nova Scotia Min. Soc. Illustrated description of the Campbell coal washing table. 1500 w. Eng & Min Jour—May 9, 1903. No. 55144.

Coke Ovens.

The Development of the Modern By-Product Coke-Oven. Christopher G. Atwater. Describes and discusses the progress made to the present date, in the development of the modern by-product coke-oven. Ill. 3300 w. Trans Am Inst of Min Engrs—Oct., 1902. No. 55384 C.

Dortmund.

The Report for 1902 of the Association of the Mining Industry in the Dortmund District, Germany (Jahresbericht des Vereins für die Bergbaulichen Interessen im Oberbergamtsbezirk Dortmund für das Jahr 1902). A report, with many statistics, on the production of coal, coke and briquettes, transportation, mining, wages, etc., with comparative tables and diagrams. 3 plates. 7000 w. Glückauf—April 11, 1903. No 55439 D.

Electrical Machinery.

See Electrical Engineering, Power Applications.

Hauling.

Compressed-Air Motors for Gathering Cars in Coal-Mines. Beverley S. Randolph. Gives a comparison of motors and mules used in gathering cars from working-places; and the comparative cost. Ill. 1000 w. Trans Am Inst of Min Engrs—Feb., 1903. No. 55389.

Irish Bogs.

See Industrial Economy.

Japan.

The Yubari Coal Mines in Japan. Gives the history, geology, methods of mining, and an illustrated description of the plant for preparing the coal. 1300 w. Mines & Min—May, 1903. No. 55053 C.

Kansas Coal Field.

The Weir-Pittsburg District of the Kansas Coal Field. Prof. W. R. Crane. A description of the district, the methods employed, and of a typical mine and tipple. Ill. 3700 w. Mines & Min—May, 1903. No. 55054 C.

Louisiana Purchase.

Coal Resources of the Louisiana Purchase. Frederick E. Saward. Notes relative to the traffic in coal within the area of country comprised within the celebrated Louisiana Purchase. 2200 w. Ir Age—May 28, 1903. No. 55501.

Shipping Appliances.

English Shipping Appliances for Coal. Illustrates and describes the methods of shipping export coal, used in the Northumberland and Durham centers and in South Wales. 2000 w. R R Gaz—May 1, 1903. No. 55092.

Working.

Some Points in the Working of a Nonfiery, Naturally Wet House Coal Seam. Discusses some of the difficulties and disturbances of small workings. 1700 w. Ir & Coal Trds Rev—May 15, 1903. No. 55372 A.

COPPER.

Analysis.

The Commercial Analysis of Copper Ore. Russell L. Dunn. Gives some interesting figures of profit and loss, and discusses the problem of profitable re-

We supply copies of these articles. See page 638.

duction. 3000 w. Pacific Coast Miner—May 9, 1903. No. 55224.

Arizona.

The Copper Deposits of Clifton, Arizona. Waldemar Lindgren. Describes the topography, geology, structure, ore deposits, and fissure veins. Ill. 2800 w. Eng & Min Jour—May 9, 1903. No. 55143.

Butte, Montana.

The Synthesis of Chalcocite and Its Genesis at Butte. Horace V. Winchell. Shows that chalcocite is the principal copper mineral of this region, and gives an experimental study showing how it was formed. 3300 w. Eng & Min Jour—May 23, 1903. No. 55349.

Nickel-Copper Ores.

See Mining and Metallurgy, Miscellany.

Smelting.

Smelting of Raw Sulphide Ores at Ducktown. W. H. Freeland. Describes work of the writer at Isabella, Tenn. The ore is a pyrrhotite, carrying less than 3 per cent. copper, and no precious values. The practice consisted in the smelting of raw ore to low grade matte, and the reconcentration of the low-grade, to a 50 per cent. matte. Ill. 1800 w. Eng & Min Jour—May 2, 1903. No. 55114.

Treatment of Lake Copper. J. B. Cooper. Read before the Lake Superior Min. Inst. A history of some of the difficulties experienced in the early efforts to smelt Lake ores and the final success. 2500 w. Mines & Min—May, 1903. No. 55061 C.

See also Mining and Metallurgy, Gold and Silver.

GOLD AND SILVER.

Alaska.

The Sea Level Mine, Alaska. W. H. Washburn. An illustrated article giving information in regard to this property. The pay ore is found mostly in gold-bearing pyrites in two white quartz veins. 2000 w. Min & Sci Pr—May 9, 1903. No. 55235.

Creede.

Creede Mining Camp. Prof. Arthur Lakes. Describes these valuable silver mines operated through the Nelson and Humphreys tunnels, and also the Humphreys mill. Ill. 2500 w. Mines & Min—May, 1903. No. 55052 C.

Cyanide.

The Regeneration of Working Cyanide Solutions, Where Zinc Precipitation is Used. Andrew F. Crosse. Describes the writer's process of regenerating cyanide solutions. 1700 w. Jour Chem & Met Soc of S Africa—March, 1903. No. 55-192 E.

Edison Dry Process.

The Edison Dry Process for the Separation of Gold from Gravel. A description of the process, authorized by Mr. Edison. Ill. 1200 w. Eng & Min Jour—May 9, 1903. No. 55145.

Gold Dredging.

Present Practice in Gold Dredging. R. H. Postlethwaite. Describes some of the newer devices which experience has shown to be advantageous. 2200 w. Mines & Min. May, 1903. No. 55060 C.

Mexico.

A Trip to Chihuahua, Old Mexico. Prof. Arthur Lakes. An illustrated description of the Descubidoro mine, with some impressions of the country, the people, and the mines. 2800 w. Mines & Min—May, 1903. No. 55057 C.

North America.

The Geological Features of the Gold Production of North America. Waldemar Lindgren. A collection of data regarding the product of each State, the derivation of the gold, showing the relative importance of different kinds of deposits, and the future outlook. 22800 w. Trans Am Inst of Min Engrs—Oct., 1902. No. 55382 D.

Quartz Milling.

Notes on the Common Practice of Quartz Milling on the Rand. Fraser Alexander. A discussion of the methods most important in securing successful results. 3500 w. Jour Chem & Met Soc of S Africa—March, 1903. No. 55193 E.

Queensland.

The Etheridge Goldfield. (Q.) An illustrated article giving information of a much neglected field. 2500 w. Aust Min Stand—April 9, 1903. Serial. 1st part. No. 55264 B.

Riecken Process.

The Riecken Process for the Extraction of Gold (Les Nouveaux Procédés d'Extraction de l'Or. Procédé Riecken). F. Schiff. An illustrated description of this electrochemical cyanide process, used particularly in West Australia for sulphide and telluride gold ores. 1000 w. Génie Civil—April 11, 1903. No. 54890 D.

Separation.

The Separation of Gold from Copper, with Especial Reference to Pyritic Smelting. F. R. Carpenter. Read at the meeting of the Colorado Sci. Soc. An account of experiments, describing processes. 1600 w. Min Rept—May 7, 1903. No. 55132.

Silver-Lead.

Treatment of Oxidized Silver-lead Ores of Aspen, Colo. S. I. Hallett. Gives results of laboratory tests that look very promising and seem worth further ex-

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perimenting. 1500 w. Min & Sci Pr—May 2, 1903. No. 55137.

Tailings.

Cyaniding Tailings in Sierra Co., Cal. H. R. Case. An account of treatment at the Young America quartz mine, near Sierra City. 1000 w. Min & Sci Pr—May 16, 1903. No. 55347.

IRON AND STEEL.

American Trade.

Some Economic Conditions Affecting the American Iron and Steel Trades. J. Stephen Jeans. Read before the Conference of the British Iron Trade Assn. Discusses the recent development of the output and capacity, the influence of the steel corporation, etc., in the present article. 2000 w. Ir & Coal Trds Rev—April 3, 1903. Serial. 1st part. No. 55151 A.

Analysis.

Standard Methods for Analyzing Iron. Outlines methods for separating and estimating carbon, phosphorus, and manganese. 13600 w. Jour Am Found Assn—May, 1903. No. 55374.

Standard Methods for Analyzing Iron. Herbert E. Field. A classification of the methods used in different laboratories, as collected by the Metallurgical Section of the Foundrymen's Assn. 5000 w. Jour Am Found Assn—2 parts, April & May, 1903. No. 55168.

Notes on the Ammonium Molybdate Precipitation for Phosphorus. J. William Beatty. Gives some results recently obtained in the laboratory of the Sweet Steel Co., Syracuse, N. Y. 800 w. Ir Age—May 28, 1903. No. 55504.

Armor-Plate.

The New Armor-Plate Mill at Creusot. Two-page plate, illustrations, and description of a recently constructed mill at the Creusot Works, which makes it possible to roll armor-plates, commercially, weighing from 60 to 65 tons. 2800 w. Engng—May 1, 1903. No. 55201 A.

Axles.

See Mechanical Engineering, Machine Works and Foundries.

Blast Furnaces.

A New Blast Furnace Top. Axel Sahlin. Read before the Iron and Steel Inst. An illustrated description of the Julian Kennedy furnace top and hoist, stating the assumptions on which the design is based, and the advantages claimed. 3500 w. Ir Age—May 14, 1903. No. 55186.

British Columbia.

The Bull River Iron Mines. C. Hungerford Pollen. An illustrated detailed description of this property with remarks on its profitable working. 1500 w. B C Min Rec—May, 1903. No. 55298 B.

Carnegie.

Andrew Carnegie: His Career and Work, his Methods, and his Achievements. J. Stephen Jeans. An outline of the development of the American iron industry and the Steel Corporation. Photographs of prominent men in this industry. 14000 w. Ir & Coal Trds Rev—May 8, 1903. No. 55333 A.

Cementation.

The Cementation of Iron (Sur la Cementation du Fer). Georges Charpy. An account of quantitative researches on the cementation of steel, with different carbonizing materials, in electric furnaces at definite temperatures. 600 w. Comptes Rendus—April 27, 1903. No. 54882 D.

Demand.

The Expanding Area of Demand for Iron and Steel. B. H. Thwaite. Calls attention to the use in architectural construction, tramway and autocar transit systems. 1200 w. Ir & Coal Trds Rev—May 1, 1903. No. 55208 A.

Europe.

The Recent Development of the European Iron Industry. Reviews the history of the industry in Germany, France, Sweden, and Norway, Russia, Belgium, Austria-Hungary, and Spain. Photographs of prominent men. 9000 w. Ir & Coal Trds Rev—May 8, 1903. No. 55334 A.

Flue Dust.

The Effect of Flue Dust upon the Thermal Efficiency of Hot-Blast Stoves. B. H. Thwaite. Investigation made to determine whether it is possible with a given heating capacity to raise the efficiency of the hot-blast stove and sustain it as near to that possessed by any well-designed recuperator of a gas-fired open-hearth furnace. 4300 w. Ir & Coal Trds Rev—May 8, 1903. No. 55331 A.

"Frozen" Furnaces.

A New Process for Removing "Frozen" Masses in Furnaces (Ein Neues Verfahren zum Schnellen Beseitigen von Ofenansätzen und Dergleichen und zum Beseitigen Hinderlicher Metallmassen). Dr. Weeren. A description of a process, due to Dr. Ernst Menne, for removing solidified masses of metal, slag, etc., from blast furnaces, etc., by burning and melting with oxygen and other gases. 2500 w. Stahl u Eisen—April 15, 1903. No. 55431 D.

The Menne Process for Removing Metallic Obstructions. Translated from *Stahl und Eisen*. Describes this process, the principle of which is to use the heat of combustion of the material which has to be removed. Gives examples of work carried out. 2000 w. Ir Age—May 21, 1903. No. 55289.

Great Britain.

The Iron-Working Districts of Great

Britain. The first of a series of articles on the present conditions and immediate outlook of the principal iron-making centers of the United Kingdom. Photographs of prominent men. 1500 w. Ir & Coal Trds Rev—May 8, 1903. Serial. 1st part. No. 55335 A.

Iron Reduction.

The Influence of Carbon, Carbonic Oxide and Carbonic Acid on Iron and Iron Oxides (Ueber die Einwirkung von Kohlenstoff, Kohlenoxyd und Kohlensäure auf das Eisen und seine Oxyde). E. Baur and A. Glaessner. An analytical-chemical investigation of the processes in the blast furnaces, and the reduction of the different oxides of iron. Diagrams. 3500 w. Stahl u Eisen—May 1, 1903. No. 55434 D.

Krupp Works.

The Krupp Works at Essen. Day Allen Willey. The first of a series of illustrated articles describing these noted works in Germany. 1800 w. Sci Am Sup—May 9, 1903. Serial. 1st part. No. 55128.

Middlesbrough Works.

The Works and Operations of the North-Eastern Steel Company, Middlesbrough-on-Tees, England. An illustrated detailed description. 6500 w. Ir & Coal Trds Rev—May 15, 1903. No. 55371 A.

Open Hearth.

The Development of the Continuous Open-Hearth Process. Benjamin Talbot. Paper read before the Iron and Steel Inst., with discussion. On recent progress and results obtained at furnaces in Pennsylvania. 7200 w. Ir & Coal Trds Rev—May 8, 1903. No. 55327 A.

The Development of the Continuous Open Hearth Process. Benjamin Talbot. Read before the Iron and Steel Inst. A report of recent progress and results obtained in the continuous process of steel making, based on recent visits to Pittsburgh plants, and the Pencoyd plant. 5000 w. Ir Age—May 14, 1903. No. 55185.

The Refining of Cast Iron by the Talbot Process (Affinage de la Fonte par le Procédé Talbot). A description of an open-hearth steel-making plant at Frodingham, England, including an oscillating furnace on the Campbell system, with other modern improvements, and its method of operation. 3000 w. Génie Civil—March 21, 1903. No. 54884 D.

The Open-Hearth Process. Lieut.-Col. Leandro Cubillo. A study of the balance of the furnace, of the temperatures, and of the oxygen in the bath, etc. 3800 w. Ir & Coal Trds Rev—May 8, 1903. No. 55328 A.

Pig Iron.

The Quality of Pig Iron for Foundry Use as Shown by Fracture and Analysis. S. B. Patterson. Read before the New England Found. Assn. Considers those influences exerted by the ordinary elements to be found in pig iron which are generally accepted as established, and things affecting the quality of castings. 4700 w. Ir Age—May 21, 1903. No. 55288.

Rolling Mills.

The Construction and Operation of a Combined Roughing and Universal Rolling Mill (Ueber Bau und Betrieb einer Kombinierten Grob- und Universalstrasse). J. Hübers. An illustrated discussion of plans for trains of rolls for large blocks and smaller shapes, to be worked together or separately. 1500 w. Stahl u Eisen—May 1, 1903. No. 55433 D.

Slag Cement.

See Civil Engineering, Materials.

Steel Constitution.

The Constitution of Steel (L'Etat Actuel de Nos Connaissances sur la Constitution des Aciers au Carbone). Léon Guillet. A review of the constitution of steel, and the combinations of iron and carbon of which it is formed, illustrated by diagrams and micrographs. Serial. 2 parts. 5000 w. Génie Civil—April 4 and 11, 1903. No. 54888 each D.

Note on the Influence of the Rate of Cooling on the Structure of Steel. Albert Sauveur and H. C. Boynton. Gives a statement of interesting facts brought to light in the course of experiments at Harvard University. Ill. 2200 w. Trans Am Inst of Min Engrs—Feb., 1903. No. 55391.

The Influence of Sulphur and Manganese on Steel. J. O. Arnold and G. B. Waterhouse. A report of an examination, by micrographic analysis, of a series of heat-treated steels prepared by Mr. Brinell. 1000 w. Ir & Coal Trds Rev—May 8, 1903. No. 55332 A.

Tempering Theory.

The Theory of the Temper of Steel (Au Sujet de la Théorie de la Trempe de l'Acier). André Le Chatelier. A discussion of the theory of tempering, and of the internal state of steel in general. 700. Comptes Rendus—March 10, 1903. No. 54868 D.

MINING.

Deep Level.

The Deep Level Problem of the Witatersrand. Briefly discusses the best type of winding engines for this work, giving an illustrated description of the Whiting double-sheave winding engine, and discussing its advantages and disadvantages. 1600 w. Engr, Lond—April 24, 903. No. 55028 A.

Drilling.

Diamond Drilling. J. N. Justice. Abstract of paper read before the Inst. of Min. & Met. Illustrates and describes boring operations in West Africa to prove the continuity of the ore chutes in depth, and to obtain information as to the dip of the formation. 2300 w. Ir & Coal Trds Rev—April 24, 1903. No. 55022 A.

The Cost of Diamond Drill Borings in the Colorado River Valley and at St. Mary's Lake, Montana. A. P. Davis. Gives extract from report of John T. Whistler describing work and giving costs, with comparison and general remarks. 1300 w. Eng News—April 30, 1903. No. 55091.

Electric Haulage.

Third-Rail Tail-Rope Haulage System. L. L. Logan. An illustrated description of an arrangement adapted to handling a large tonnage in a difficult place. 1400 w. Mines & Min—May, 1903. No. 55062 C.

Flumes.

Flume Construction. W. C. Ralston. Read before the California Miners' Assn. An accurate account of costs of construction of a flume in Calaveras County, California, with descriptive notes. Ill. 600 w. Eng & Min Jour—May 23, 1903. No. 55351.

Gas Detection.

Detection of Small Percentages of Gas in Mine Air. J. T. Beard. Describes an attachment for safety lamps by which the presence of small amounts of gas is made visible. 2500 w. Mines & Min—May, 1903. No. 55059 C.

Roads.

Roads for Mines. James W. Abbott. Discusses the essential points in this branch of the engineer's practice. Location, grade, staking out the line, and details of construction are considered in the present article. Ill. 3000 w. Eng & Min Jour—May 16, 1903. Serial 1st part. No. 55227.

Safety Explosives.

Experiments with Safety Explosives (Mitteilungen der Berggewerkschaftlichen Versuchsstrecke. Versuche mit Sicherheitssprengstoffen). Hr. Beyling. An account of experiments with various safety explosives for coal mines, undertaken at the mining companies' testing plant at Gelsenkirchen, Germany. 3500 w. Glückauf—May 9, 1903. No. 55443 D.

Tailings Elevator.

Peck's Centrifugal Tailings Elevator. F. Danvers Power. Illustrated description of a new tailings elevator designed to supersede the heavy and costly ladder type used on gold dredges. States the advantages claimed. 1000 w. Eng & Min Jour—May 23, 1903. No. 55350.

Timbering.

Systematic Timbering in Continental Mines. The present article illustrates and describes methods used in the north of France and Belgium. 2000 w. Col Guard —April 24, 1903. Serial. 1st part. No. 55020 A.

Timbering in the Collieries of Saxony and Austria. Illustrates and describes methods as reported by the Prussian Commission on "Falls of Roofs in Mines." 1300 w. Ir & Coal Trds Rev—May 1, 1903. No. 55209 A.

MISCELLANY.

Alaska.

Mineral Resources of Southeastern Alaska. William M. Brewer. Information relating to the Ketchikan mining district. The ores carry variable values in gold, silver, copper, etc. 1800 w. Min & Sci Pr—May 16, 1003. No. 55346.

Australia.

The Australian Mining Industry. J. L. C. Rae. Extracts from the presidential address delivered to the members of the Engng. Assn. of N. S. W. 2400 w. Aust Min Stand—March 26, 1903. Serial. 1st part. No. 55263 B.

Canada vs. U. S.

Mineral Production, Canada and United States. George Johnson. A comparison of the development of the two countries, based on the statistics for 1901. 2800 w. Can Min Rev—April 30, 1903. No. 55034 B.

Canadian Rockies.

Mining Possibilities of the Canadian Rockies. Bernard MacDonald. Discusses the possibilities of this region in regard to the mining and production of the precious metals, suggesting method for their exploration. Maps. 7000 w. Can Min Rev—April 30, 1903. No. 55032 B.

Electric Prospecting.

See Electrical Engineering, Miscellany.

Granite.

See Civil Engineering, Materials.

Helicoidal Wire.

Stone Cutting with the Helicoidal Wire (Le Sciage des Roches par le Fil Héliçoidal). A brief illustrated description of this method of sawing rock and quarrying stone with a helicoidal steel wire. 000 w. Génie Civil—March 28, 1903. No. 54886 D.

Law.

The Latest Montana Mining Decision. Dr. R. W. Raymond. Discusses the change in the Supreme Court's decision in the Pennsylvania case, giving the portion covering the modification. 4000 w. Eng & Min Jour—May 9, 1903. No. 55142.

Manganese.

Manganese in the Upper Black Forest,

Baden (Die Manganerz-Vorkommen im Oberen Schwarzwald, Grossherzogthum Baden). Josef Lowag. A description of occurrences of manganese ore and the general geological formation of this region in Germany. 1200 w. Oesterr Zeitschr f Berg u Hüttenwesen—March 14, 1903. No. 55480 D.

Mexico.

The Geographical and Geological Distribution of the Mineral Deposits of Mexico. José G. Aguilera. Discusses the minerals separately, locating the principal deposits. 9500 w. Trans Am Inst of Min Engrs—Nov., 1901. No. 55392 C.

Miner's Phthisis.

Miners' Phthisis. Discussion of paper by William Cullen. 900 w. Jour Chem & Met Soc of S Africa—March, 1903. No. 55194 E.

Newfoundland.

Mining in Newfoundland. J. P. Howley. From the annual report to the Minister of Agriculture and Mines. 2000 w. Can Min Rev—April 30, 1903. No. 55035 B.

Nickel-Copper.

A Process for Separating Copper and Nickel from Magnetic Gravels (Verfahren zur Gewinnung von Kupfer und Nickel aus Kupfer und Nickelhaltigen Magnetkiesen). E. Günther. An abstract of an inaugural dissertation on an electrolytic process for extracting nickel and copper separately after metallurgical treatment of the ore. 5000 w. Zeitschr d Ver Deutscher Ing—April 18, 1903. No. 55446 D.

Nickel Steel.

Researches in Nickel Steel (Recherches sur les Aciers au Nickel). Léon Guillet. A micrographic and mechanical study of nickel steel and its properties, with micrographs, diagrams and tables. Serial. 3 parts. 9000 w. Génie Civil—May 2, 9 and 16, 1903. No. 54897 each D.

Ore Deposits.

Ore-Deposits Near Igneous Contacts. Walter Harvey Weed. Deals with ore-deposits whose structural features or mineral contents result, directly or indirectly, from igneous intrusions and their after-effects. 12000 w. Trans Am Inst of Min Engrs—Oct., 1902. No. 55393 C.

Some Practical Suggestions Concerning the Genesis of Ore Deposits. Max Boehmer. A study of the action of underground waters, their sourse of supply, etc. 2000 w. Trans Am Inst of Min Engrs—July, 1903. No. 55387.

Ore-Deposition and Vein-Enrichment by Ascending Hot Waters. Walter Harvey Weed. Gives conclusions from a study of the copper veins of Butte, Montana, and other deposits. 3000 w. Trans Am Inst of Min Engrs—Oct., 1902. No. 55386.

The Secondary Enrichment of Ore Deposits. George Smith. Discussion of the paper of S. F. Emmons, presented at the Washington meeting, Feb., 1900. 1500 w. Trans Am Inst of Min Engrs—Oct., 1902. No. 55388.

The Syncline as a Structural Type. T. A. Rickard. A consideration of this class of ore deposits. Ill. 1000 w. Eng & Min Jour—May 16, 1903. No. 55228.

Petroleum.

California Petroleum and Its Use as Fuel. A. M. Hunt. Reviews the development, giving interesting report of output and the number of wells in operation, and discussing the effect upon the fuel situation on the Pacific Coast. Ill. 2700 w. Jour of Elec—May, 1903. No. 55505 C.

Petroleum in New Zealand. Henry A. Gordon. An outline of the efforts made to test the oil-fields, and the conclusions reached. 2000 w. N Z Mines Rec—March 16, 1903. No. 55129 B.

Petroleum from a Chemist's Standpoint. Edmond O'Neill. Briefly considers its origin, distribution, exploitation, properties and uses. 2700 w. Jour of Elec—May, 1903. No. 55506 C.

Quarries.

The Caledonian Granite Company's Quarries, Kippford, Near Dalbeattie. Illustrated description of these quarries in Scotland. 1800 w. Quarry—May 1, 1903. No. 55265 A.

Quarrying.

Quarrying in the United States (L'Exploitation des Carrières aux Etats-Unis). A. de Gennes. An illustrated account of methods of working marble and other quarries in the United States. 1 plate. 2500 w. Mem Soc Ing Civils de France—March, 1903. No. 55408 G.

Queensland.

Queensland Mining Industry. Report of the under-secretary of mines, Mr. A. R. Macdonald, reviewing the year 1902. Maps. 20000 w. Queens Gov Min Jour—March, 1903. No. 54999 B.

Roasting.

Some Notes on Roasting with McDougall Furnace. S. S. Sorensen. A report of the working of a set of eight McDougall calcining furnaces at the Highland Boy smelter, Utah, commending their simplicity, economy, and efficiency. Ill. 2500 w. Can Min Rev—April 30, 1903. No. 55033 B.

Salt Cars.

East Galician Salt Cars (Ostgalizischer Salztransportwagen). Eduard Windakiewicz. An illustrated description of hand cars which have been introduced in salt

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works to carry the salt in process of manufacture from one part of the works to another, thereby eliminating man transport. 1 plate. 1200 w. Oesterr Zeitschr f Berg u Hüttenwesen—March 28, 1903. No. 55482 D.

Salt Works.

The Salt Works of Rosières-Varangéville, France (Die Saline Rosières-Varangéville). Victor Wenhart. A description of salt mines and works in the north of France. 2000 w. Oesterr Zeitschr f Berg u Hüttenwesen—March 21, 1903. No. 55481 D.

Tasmania.

Tasmania Mining and Metallurgy. Donald Clark. The first of a series of articles describing the mining and metallurgical resources of Tasmania, and the development. Ill. 2300 w. Aust Min Stand—March 12, 1903. Serial. 1st part. No. 55122 B.

Turquoise.

The Burro Mountain Turquoise District. George D. Reid. An account of this district in New Mexico, the mines, quality of stones, value, etc. 1500 w. Eng & Min Jour—May 23, 1903. No. 55352.

Zinc.

The Metallurgy of Zinc. Dr. J. Ohly. Discusses the furnaces employed at Joplin, Mo., describing a recent invention of Wm. C. Wetherill and discussing other improvements under consideration. 2300 w. Min Rept—May 14, 1903. No. 55250.

Electrolytic Zinc Extraction by the Hoepfner Process. E. Guenther. An illustrated account of this process, cost of plant and operation. 2500 w. Eng & Min Jour—May 16, 1903. No. 55229.

Zinc and Lead.

Zinc- and Lead-Deposits of Northern Arkansas. George I. Adams. Preliminary statement of results and conclusions based on a study of these deposits. 4800 w. Trans Am Inst of Min Engrs—Feb., 1903. No. 55390.

RAILWAY ENGINEERING

CONDUCTING TRANSPORTATION.

Accidents.

Accidents on French Railways in 1900 (Les Accidents sur les Chemins de Fer Français en 1900). Statistics of railway accidents in France, and also general railway statistics of the world. 1000 w. Rev Technique—April 25, 1903. No. 55423 D.

Government Accident Bulletin No. 6. Reviews the sixth quarterly bulletin of the Interstate Commerce Commission. The total number of casualties is 12,811. 3200 w. R R Gaz—May 8, 1903. No. 55124.

Train Accidents in the United States in April. Condensed record, with editorial notes on the most serious. 2500 w. R R Gaz—May 22, 1903. No. 55326.

MOTIVE POWER AND EQUIPMENT.

Brakes.

The Siemens System of Electrically Controlled Air Brakes (Elektrische Steuerung für Luftdruckbremsen. Siemens-Bremse). An illustrated description of an improved system in use on German railroads, by which the air-brakes can be operated electrically from any part of the train, and which possesses, besides, all the usual advantageous features of air brakes. 2500 w. Glasers Annalen—May 1, 1903. No. 55452 D.

A Study of Brakes (Etude sur les Freins). E. Billy and H. Noalhat. A discussion of shoe brakes for cars and other vehicles, from both theoretical and practical standpoints. Serial. Part I. 3500 w. Rev Tech—April 25, 1903. No. 55421 D.

See also Street and Electric Railways.

Brake-Shoes.

The Structure and Service of Modern Brake-Shoes. F. W. Sargent. Considers the function of the brake-shoe, explaining the action of various shoes, the effect of heat on the different types, work, wear, etc. 4500 w. Pro Pacific Coast Ry Club—April 18, 1903. No. 55170.

Buffer.

Radial Spring Buffer Between Engine and Tender. Brief illustrated description of a design of the Phila., Wilmington, and Baltimore R. R. The locomotives equipped with it are intended to run upon curves of 70-foot radius. 500 w. Loc Engng—May, 1903. No. 55071 C.

Car Lighting.

See Gas Works Engineering.

Cars.

Increasing the Capacity of Cars (Die Bestrebungen auf Erhöhung der Tragfähigkeit von Güterwagen). Hr. Engel. A discussion of British reports on American transportation and comparisons of American, British and German cars, particularly for coal and other heavy freight. Illustrations. 6 plates. 6000 w. Glückauf—May 2, 1903. No. 55442 D.

Some New English and Continental Passenger Cars. Illustrations and brief descriptions of sleeping cars and dining cars. 800 w. R R Gaz—May 22, 1903. No. 55325.

Coal Shipping.

See Mining and Metallurgy, Coal and Coke.

We supply copies of these articles. See page 638.

Couplers.

Automatic Couplers on British Railways. T. A. Brockelbank. Discusses their use in other countries, the danger to employes in coupling cars, traffic delays, etc., urging the adoption of automatic couplers. General discussion. Ill. 9400 w. Jour Soc of Arts—May 1, 1903. No. 55187 A.

Automatic Coupling for Railway Cars (Attelage Automatique des Wagons). G. Mareschal. An illustrated description of an automatic coupling, invented by M. Boirault, which is being experimented with on French railways. 1000 w. Génie Civil—April 25, 1903. No. 54895 D.

Gasoline Vehicles.

See Mechanical Engineering, Automobiles.

Journal Box.

The Improved Symington Journal Box. Gives the causes of failure of journal boxes, and describes the improvements made in this design. Ill. 1000 w. R R Gaz—May 8, 1903. No. 55125.

Locomotive Efficiency.

Experiments on the Efficiency of Locomotives (Expériences sur le Rendement des Locomotives). Joseph Nadal. An illustrated account of tests on Franch railways to determine the performance and efficiency of locomotives of various types, with particular reference to the action of the steam in the cylinders. Tables and diagrams. 1 plate. 9000 w. Rev Gén des Chem de Fer—May, 1903. No. 55405 H.

To Make Compound Locomotives Efficient. W. A. Buckbee. Discusses various types and the need of a better understanding of the construction and operation of these engines in the service for which they are adapted. 1800 w. Loc Engng—May, 1902. No. 55070 C.

Locomotives.

British Locomotives in 1902. Charles Rous-Marten. Remarks on the general tendency, with illustrated descriptions of designs, and report of the performances that show progress. 5700 w. Bul Internat Ry Cong—April, 1903. No. 55379 E.

Compound Passenger Locomotives on the Eastern Railway of France. Charles S. Lake. An illustrated description of engines in use on the Chemins de Fer de l'Est. 1500 w. Prac Engr—May 15, 1903. Serial. 1st part. No. 55361 A.

Consolidation (2-8-0) Locomotives for the South Buffalo Railway. Illustrates and describes engines for handling heavy freight traffic over a hilly road. 800 w. R R Gaz—May 8, 1903. No. 55126.

Express Engine, Western Railway of France. Two-page plate, with description of four-cylinder compound locomotives used for express service. 2200 w. Engr, Lond. May 15, 1903. No. 55370 A.

Four-Cylinder Compound for the Jura-Simplon. Camille Barbey. Translated from the *Revue Generale des Chemins de Fer*. Illustrated detailed description. 700 w. R R Gaz—May 1, 1903. No. 55093.

Suburban Locomotive Development. An illustrated description of types, showing the development since 1860. 3000 w. R R Gaz—May 15, 1903. No. 55211.

Tandem Compounds for the New York Central. Illustration, cross sections, dimensions, and general information. 1100 w. Ry Age—May 15, 1903. No. 55252.

Tandem Compound Freight Locomotive. Illustrated description of the powerful locomotives of the 2-8-0 type, belonging to class known as G-4. 800 w. Am Engr & R R Jour—May, 1903. No. 55074 C.

Tank Engine, London and Brighton Railway. Illustration and leading dimensions of a very powerful engine. 250 w. Engr, Lond—May 1, 1903. No. 55205 A.

Ten-Wheeled Locomotive for the Letterkenny and Burtonport Railway. Two-page plate with brief description of one of four recently built locomotives. 400 w. Engng—April 24, 1903. No. 55026 A.

The Great Eastern Railway "Decapod." James Holden. Introductory remarks on the needs of British railways, with illustrated description of this powerful engine and its operation. 2000 w. Cassier's Mag—May, 1903. No. 55180 B.

Logging Locomotives.

Logging Locomotives. Illustrations of a novel design used in Canada, with brief description. 700 w. Engng—May 8, 1903. No. 55282 A.

Motor Coaches.

Motor Coaches for British Railroads. Illustration and brief description of a steam motor coach built for the London and South-Western Railway. 1200 w. Sci Am—May 23, 1903. No. 55313.

Seamless Wheel.

The Ehrhardt Seamless Car Wheel (Nahtloses Speichenrad, Patent Ehrhardt). An illustrated description of a spoke wheel for railway cars in which the hub and spokes are forged from a single block of steel. 900 w. Stahl u Eisen—April 15, 1903. No. 55432 D.

Slipping.

Slipping of Locomotives at High Speeds. C. E. Wolff. A study of the conditions under which slip takes place, giving results of tests and conclusions. 800 w. Mech Engr—May 9, 1903. No. 55271 A.

Staybolts.

The Use of Steel Staybolts in Locomotive Fireboxes (Ueber Verwendung von Flusseisernen Stehbolzen zu den Feuerkisten der Lokomotiven). Hr. Meunnert.

We supply copies of these articles. See page 638.

An illustrated account of favorable experience with steel staybolts on German railways. 1000 w. Glasers Annalen—May 1, 1903. No. 55453 D.

Steel Cars.

Steel Cars on the Bessemer and Lake Erie Railroad. Drawings and information showing the development on this road. 2500 w. Am Engr & R R Jour—May, 1903. No. 55072 C.

Train Signals.

Permanent Communication Between Moving Trains (Intercommunication Permanente des Trains en Marche). Emile Dieudonné. Description of a system invented by Senor Basanta, by which moving trains are connected telephonically with each other and with the nearest stations, and by which the different cars of a train are in telephonic communication. 2500 w. Rev Tech—March 25, 1903. No. 55418 D.

NEW PROJECTS.

Africa.

New Railways in Southeast Africa. Sketch showing the routes of present lines and the approximate routes of authorized lines, with information relating to them. 500 w. U S Cons Repts, No. 1651—May 20, 1903. No. 55287 D.

Grand Trunk.

The Grand Trunk Pacific Railway. Map and information relating to a proposed transcontinental railway from Quebec to the Pacific Coast. 1300 w. Ry Age—May 22, 1903. No. 55341.

London.

Extension of Clapham Junction Station—London and South-Western Railway. Plans and description of an extensive engineering work in progress, which will provide eight running tracks and a loop line between the Junction and the terminal station at Waterloo. 1800 w. Engr, Lond—May 1, 1903. No. 55206 A.

Ohio.

Location and Construction of the Ohio Residency, Pittsburg, Carnegie & Western R. R. Describes interesting engineering features on the portion of this line lying within the state of Ohio, also the methods used, giving costs of certain kinds of work. 4400 w. Eng News—May 21, 1903. No. 55319.

Trans-Andine.

The Trans-Andine Railway. Gives a synopsis of the Trans-Andine Railway bill recently passed by the Chilean Congress. 1500 w. U S Cons Repts, No. 1636—May 2, 1903. No. 54997 D.

PERMANENT WAY AND BUILDINGS.

Rail-Concrete.

Rail-Concrete Masonry on the New York, Ontario and Western. Illustrations and brief description showing method of using concrete masonry built on a foundation of old rails. 400 w. R R Gaz—May 22, 1903. No. 55324.

Shops.

Railroad Repair Shop Design and Equipment. George A. Damon. Considers present tendencies in new and reconstructed shops, introducing a general discussion of shop problems. 15800 w. W Ry Club—April 21, 1903. No. 55257 C.

Signalling.

Automatic Block Signals—C. M. & St. P. Ry. W. H. Elliott. An illustrated description of a recent installation on 14 miles of double track between Savanna, Ill., and Green Island, Ia. 1800 w. Ry Age—May 1, 1903. No. 55043.

Colonel Yorke's Report on Signal Practice in America. Charles Hanell. A reply to the portion of this report bearing on automatic signals. 1400 w. Ry & Engng Rev—May 2, 1903. No. 55031.

See also Railway Engineering, Motive Power and Equipment.

Stations.

New Stations for the National of Mexico and the Chicago & Northwestern. Illustrates and describes these stations, located at Sioux City, Iowa, and Monterey, Mexico. 1100 w. R R Gaz—May 8, 1903. No. 55123.

Terminals.

St. Louis Terminals Up-to-Date. Jno. J. Baulch. A report showing the importance of this city as a railroad center, and giving information of interest. 5500 w. St Louis Ry Club—April 10, 1903. No. 55171.

Tie-Notching Machine.

See Mechanical Engineering, Machine Works and Foundries.

Tie Plugs.

Concerning Hardwood Plugs to Hold Spikes in Soft Wood Ties. Quotes views of C. P. Sandberg, the well known European consulting engineer on rails and railways, and gives editorial suggestion. 1000 w. Eng News—April 30, 1903. No. 55089.

Ties.

Metal Ties in Germany. Translated extract from *Das Eisenbahngleis* by A. Haarmann. Describes metal ties used on the Georgs-Marien-Hutten railroad. Ill. 600 w. R R Gaz—May 15, 1903. No. 55212.

TRAFFIC.

Rates.

Grain Rates Declared Too High. Reviews the decision of the Interstate Commerce Commission holding that the advance made recently in freight rates on

We supply copies of these articles. See page 638.

grain and grain products from the west to the Atlantic seaboard is not justified. 1400 w. R R Gaz—May 1, 1903. No. 55094.

MISCELLANY.

Accounts.

The Need of a Depreciation Fund in Railway Accounts. Charles H. Grinling. A discussion of British railway finance. Considers that, under the present financial practice, such parts of a railway and its equipment as are liable to wear out and need to be replaced are wrongly dealt with. 3300 w. Bankers' Mag, Lond—May, 1903. No. 55064 C.

Address.

Mr. John F. Wallace on Railroading. Extracts from a lecture delivered at Chicago. Reviews the growth of the present railway systems, the organization and operation. 3300 w. Ry & Engng Rev—May 23, 1903. No. 55344.

American Railways.

Railway Traffic. An editorial review of the "Report on a Visit to America," by Lieut.-Col. H. A. Yorke. Considers steam railroads, tramways, subways and elevated lines, and high-speed interurban railways. 4200 w. Builder—April 25, 1903. No. 54998 A.

Education.

The Higher Education of Railway Officials. Rev. Henry A. Stimson. A discussion of the special education needed by the men who have charge of railways in their larger relations. 2300 w. Ry Age—May 1, 1903. No. 55042.

Light Traffic.

Concerning Railways of Light Traffic. Editorial discussion of construction and operation costs, giving statistics compiled from the annual report of the Maine R. R. Commission for 1902. 4500 w. Eng News—April 30, 1903. No. 55090.

Track Foremen.

A Track Foreman's Qualifications. J. E. Conley. Part of a graduating thesis by a writer who has had years of railroad service. 3300 w. R R Gaz—May 1, 1903. No. 55095.

STREET AND ELECTRIC RAILWAYS

Address.

Electric Railways. H. M. Brinckerhoff. Abstract from a lecture before the night classes of the Lewis Institute as one of a series of semi-popular talks on engineering subjects. Ill. 4800 w. Jour W Soc of Engrs—April, 1903. No. 54992 D.

Appleyard Lines.

The Appleyard Syndicate's Interurban System. Map and illustrated description of an extensive electric railway system in Ohio, the lines in operation and proposed, their equipment, etc., with account of present business. 5400 w. St Ry Jour—May 16, 1903. Serial. 1st part. No. 55253 D.

Brake.

The Westinghouse Electromagnetic Brake (Frein Electromagnétique Westinghouse). M. Delas. A discussion of braking and an illustrated description of the Westinghouse-Newell brake for electric cars. 2500 w. Bull Soc Internat des Elect—April, 1903. No. 55413 H.

See also Railway Engineering, Motive Power and Equipment.

Cars.

Double-Deck Cars in Great Britain. Discusses the popularity of these cars in Great Britain, giving opinions of various authorities explanatory of their use there, after being generally discarded in America and on the Continent. 2300 w. St Ry Jour—May 2, 1903. No. 55097 D.

New Emergency Line Car. James H. Creedon. Illustrated description of a car embodying several new ideas which has recently been constructed for the Old Colony St. Ry. Co. in Massachusetts. 800 w. St Ry Rev—May 20, 1903. No. 55306 C.

Conduit Construction.

Conduit Construction in Brussels. Illustrated article showing the method of laying the conduit, which is laid on the side and forms one of the track rails. 1000 w. St Ry Jour—May 2, 1903. No. 55098 D.

Du Bois, Pa.

Improvements in the Du Bois Electric and Traction System. Illustrates and describes the improvements since the consolidation of the two companies controlling the electric interests. 3000 w. St Ry Jour—May 9, 1903. No. 55130 D.

Fenders.

New Automatic Fender and Wheel Guard. Illustrates and describes a fender of this type and its operation. The invention of W. T. Watson. 1100 w. Sci Am—May 30, 1903. No. 55522.

Freight.

The Carriage of Goods on Electric Tramways. Alfred H. Gibbings. Abstract of a paper before the Manchester Section of the Inst. of Elec. Engrs. The present article considers the existing methods and cost of conveying goods, and begins a discussion of proposed methods. 3000 w. Prac Engr—May 1, 1903. Serial. 1st part. No. 55210 A.

We supply copies of these articles. See page 638.

Huddersfield, Eng.

Huddersfield Corporation Tramways. An illustrated article describing the change from steam to electric traction. 3000 w. Tram & Ry Wld—April 9, 1903. No. 55017 B.

Italian Lakes.

Electric Railway from Milan to Gallarate and the Italian Lakes (Conditions d'Etablissement et d'Exploitation du Réseau Electrique de Milan à Gallarate et aux Lacs Italiens). M. de Marchena. An illustrated description of the construction and operation of this electric railway, generating stations and rolling stock. Triphase current is generated and then converted to direct current in rotary substations. 10000 w. Bull Soc Internat des Elect—April, 1903. No. 55412 H.

The Milan-Gallarate-Porte Ceresio Railway. An illustrated description of prominent features of a third-rail system, with high-tension transmission lines and rotary converter sub-stations. 1700 w. Elect'n, Lond—May 8, 1903. Serial. 1st part. No. 55275 A.

Load Diagrams.

Some Interesting Properties of Load Diagrams for Electric Railways (Ueber einige Interessante Eigenschaften des Belastungsdiagrammes Elektrischer Vollbahnen für Personenverkehr). Gustav W. Meyer. A discussion of passenger traffic and operation of electric railways, based on some load diagrams of the New York Elevated Railway. 3000 w. Zeitschr f Elektrotechnik—April 12, 1903. No. 55472 D.

London.

Electrification of the London County Council Tramways. An illustrated detailed description of the work of constructing this conduit system, with information relating to it, its electrical equipment, cars, stations, etc. 9000 w. Tram & Ry Wld—May 14, 1903. No. 55373 B.

The London County Council Electric Tramways. An illustrated description of the construction and equipment of the Westminster-Tooting section. 10000 w. Elec Rev, Lond—May 15, 1903. No. 55367 A.

The London County Council Tramways. Gives a sketch of the general history and scope of the scheme, and an illustrated detailed description of the plant and equipment. A conduit line. 2200 w. Elect'n, Lond—April 24, 1903. Serial. 1st part. No. 55011 A.

The Hampton Court Line of the London United Tramways Company. Brief illustrated description of a branch line recently opened in England. 1200 w. Elect'n, Lond—April 24, 1903. No. 55012 A.

London Underground.

The Electrically-Equipped Trains for the District Railway. Illustrates and describes the equipment and the systems of electrical control. 2500 w. Elect'n, Lond—April 24, 1903. Serial. 1st part. No. 55010 A.

The Whitechapel and Bow Railway. Illustrated description of a road representing modern British practice in the construction of a first-class double main line in cut and cover and in tunnel, or a shallow-tunnel subway. 1800 w. Engng—May 1, 1903. Serial. 1st part. No. 55200 A.

Los Angeles.

The Los Angeles and the Pacific Electric Railway System, Los Angeles, Cal. An illustrated description of the urban and interurban systems which have recently been consolidated by the Huntington-Hellman syndicate, and at present aggregate over 300 miles of track. 7500 w. St Ry Rev—May 20, 1903. Serial. 1st part. No. 55305 C.

Mersey, Eng.

The Electrification of the Mersey Railway. A brief account of the history of the original undertaking, with illustrated description of the change from steam to electric power. 5500 w. Engng—April 24, 1903. No. 55023 A.

The Electrification of the Mersey Railway. An illustrated description of the electrical equipment, with a comprehensive account of this important undertaking. It is the first steam line in England on which electric motors have displaced steam locomotives. 5000 w. Tram & Ry Wld—April 9, 1903. No. 55016 B.

New York Elevated.

The Electric Cars of the New York Elevated Railway (Die Wagen der New Yorker Hochbahn). S. G. Freund. An illustrated description of the cars of the New York Elevated Railway, which is operated on the multiple-unit system. 1200 w. Elektrotech Zeitschr—May 7, 1903. No. 55459 B.

Paris Metropolitan.

The Construction of the North Circular Section of the Paris Metropolitan Railway (Le Metropolitain de Paris. Construction de la Circulaire Nord). A. Dumas. A well illustrated description of the construction of this underground and elevated section of the line, principally of the elevated structure. 1 plate. 5000 w. Génie Civil—March 28, 1903. No. 54885 D.

The Construction of the South Circular Section of the Paris Metropolitan Railway (Le Metropolitain de Paris. Construction de la Circulaire Sud. Viaduc sur la Seine à Passy). A. Dumas.

We supply copies of these articles. See page 638.

A well illustrated description of the construction of this section of the line, including the viaduct over the Seine, at Passy. 2 plates. 4500 w. Génie Civil—April 4, 1903. No. 54887 D.

The Courcelles-Ménilmontant Section of the Paris Metropolitan Railway (Le Métropolitain de Paris. Ligne du Boulevard de Courcelles à Ménilmontant). A. Dumas. A well illustrated description of this underground section of the line, through the heart of the city. 1 plate. 5000 w. Génie Civil—April 11, 1903. No. 54889 D.

Paris-Versailles.

The Electric Railway from Paris to Versailles. C. L. Durand. Brief illustrated description of the technical equipment and engineering features. 2700 w. Elec Rev, N. Y.—May 23, 1903. No. 55512.

Pavements.

Asphalt Pavement and Street Railway Tracks. W. Boardman Reed. An illustrated description of the tracks on Third Ave., N. Y., protected by the "Mullen Marginal Protecting Strip," with report of the wear. 1300 w. St Ry Jour—May 23, 1903. No. 55345 D.

Pavements Adjoining Rails. Daniel B. Luten. Notes the hard wear at this point, and recommends the use of brick to reinforce the asphalt at the rails. Ill. 1000 w. St Ry Rev—May 20, 1903. No. 55308 C.

Rails.

The Life of Tramway Rails. R. P. Wilson. Considers facts learned by experience in regard to prolonging the life of rails. Ill. 800 w. Tram & Ry Wld—April 9, 1903. No. 55019 B.

Rowan Steam Car.

Mechanical Traction of Tramways. Translated from *La Nature*. Illustrates and describes a Rowan steam motor car. 1700 w. Sci Am Sup—May 30, 1903. No. 55524.

Seattle-Tacoma.

The Seattle-Tacoma Interurban Railway. Howard S. Knowlton. Illustrated description of a high-speed electric railway on the third-rail system; the equipment, roadbed, track and right of way conform closely to steam railway practice. 6800 w. St Ry Jour—May 2, 1903. No. 55096 D.

Storage Battery Locomotive.

A Twenty-Ton Storage Battery Switching Engine. Describes a locomotive for shifting cars while loading or unloading, and for transferring material from one shop to another. 1200 w. Eng Rec—May 16, 1903. No. 55233.

Stray Currents.

See Electrical Engineering, Miscellany.

Surface-Contact.

Surface Contact Systems.—The Lorain System. Report by Mr. C. E. C. Shawfield, borough electrical tramway engineer to the Wolverhampton Corporation, on the surface contact tramways running in that town. Also brief notes on other systems. 6000 w. Elect'n, Lond—April 24, 1903. No. 55015 A.

Third Rail.

The Third Rail for High Speed Electric Service. Ernest Gonzenbach. Discusses interurban railways having a schedule speed of 20 miles per hour and above, considering construction details, and related matters. General discussion. 10600 w. Jour W Soc of Engrs—April, 1903. No. 54991 D.

Three-Wire.

The Grenoble-Chapareillan Tramway. Brief illustrated description of a three-wire system, with 1200 volts between the outers, installed in France. 600 w. Elect'n, Lond—April 24, 1903. No. 55013 A.

Trunk Lines.

Electricity as a Motive Power on Trunk Lines. C. L. de Muralt. A paper claiming to show that it would be a great advantage both from an engineering and financial standpoint to have all trains propelled by electricity. A reply to the paper by Mr. Cornelius Vanderbilt. 3500 w. N Am Rev—May, 1903. No. 55153 D.

Tube Railways.

Tube Railways and the Law of Compensation. W. Valentine Ball. A discussion of British law as affecting these railways in the county of London. 4000 w. Trac & Trans—May, 1903. No. 55279 E.

Valtellina.

The Valtellina High-Voltage Polyphase Electric Railway (Die Valtellina-Hochspannungs-Drehstrom-Vollbahn). Eugen Cserháti. An illustrated description of this electric railway near Lake Como, Italy, on the Ganz tri-phase system, and its power station, rolling stock, and overhead construction. Serial. 2 Parts. 3500 w. Elektrotech Zeitschr—April 23 and 30, 1903. No. 55454 each B.

The Electric Equipment of the Valtellina Railway in Upper Italy (Elektrische Einrichtung der Valtellina-Bahn in Ober-Italien). Eugen Cserháti. A well illustrated description of this electric railway on the Ganz tri-phase system. 5000 w. Zeitschr d Oesterr Ing u Arch Ver—March 27, 1903. No. 55479 B.

The Valtellina Railway. An account of the circumstances under which the project was carried out, with detailed description of the plant. Ill. 1500 w. Elect'n, Lond—April 24 and May 1, 1903. Serial. 2 parts. No. 55014 each A.

We supply copies of these articles. See page 638.

EXPLANATORY NOTE—THE ENGINEERING INDEX.

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cts. The letter A, B or C denotes a price of 40 cts.; D, of 60 cts.; E, of 80 cts.; F, of $1.00; G, of $1.20; H, of $1.60. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

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THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED.

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the Index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *t-m*, a tri-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

Alliance Industrielle. *m.* Brussels.
American Architect. *w.* Boston.
American Electrician. *m.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Gas Light Journal. *w.* New York.
American Jl. of Science. *m.* New Haven, U.S.A.
American Machinist. *w.* New York.
American Shipbuilder. *w.* New York.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. d Ing. e d Arch. Ital. *w.* Rome.
Architect. *w.* London.
Architectural Record. *qr.* New York.
Architectural Review. *s-q.* Boston.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Sydney.
Autocar. *w.* Coventry, England.
Automobile. *m.* New York.
Automobile Magazine. *m.* New York.
Automotor & Horseless Vehicle Jl. *m.* London.
Beton und Eisen. *qr.* Vienna.
Brick Builder. *m.* Boston.
British Architect. *w.* London.
Brit. Columbia Mining Rec. *m.* Victoria, B. C.
Builder. *w.* London.
Bulletin American Iron and Steel Asso. *w.* Philadelphia, U. S. A.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bull. Soc. Int. d Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bull. Int. Railway Congress. *m.* Brussels.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *m.* Montreal.
Canadian Mining Review. *m.* Ottawa.
Cassier's Magazine. *m.* New York.
Central Station. *m.* New York.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Compressed Air. *m.* New York.
Comptes Rendus de l'Acad. des Sciences. *w.* Paris.
Consular Reports. *m.* Washington.
Deutsche Bauzeitung. *b-w.* Berlin.
Domestic Engineering. *m.* Chicago.
Electrical Engineer. *w.* London.
Electrical Review. *w.* London.

Electrical Review. *w.* New York.
Electrical World and Engineer. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Electricity. *w.* London.
Electricity. *w.* New York.
Electrochemical Industry. *m.* Philadelphia.
Electrochemist and Metallurgist. *w.* London.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnische Zeitschrift. *w.* Berlin.
Elettricita. *w.* Milan.
Engineer. *w.* London.
Engineer. *s-m.* Cleveland, U. S. A.
Engineering. *w.* London.
Enginering and Mining Journal. *w.* New York.
Enginering Magazine. *m.* New York & London.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penna. *m.* Pittsburg, U.S.A.
Feilden's Magazine. *m.* London.
Fire and Water. *w.* New York.
Foundry. *m.* Cleveland, U. S. A.
Gas Engineers' Mag. *m.* Birmingham.
Gas World. *w.* London.
Génie Civil. *w.* Paris.
Gesundheits-Ingenieur. *s-m.* München.
Giorn. Dei Lav. Pubb. e. d. Str. Ferr. *w.* Rome.
Glaser's Ann. f Gewerbe & Bauwesen. *s-m.* Berlin.
Ice and Refrigeration. *m.* New York.
Ill. Zeitschr. f. Klein u. Straussenbahnen. *s-m.* Berlin.
Ingeneria. *b-m.* Buenos Ayres.
Ingenieur. *w.* Hague.
Insurance Engineering. *m.* New York.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron and Steel Trades Journal. *w.* London.
Iron Trade Review. *w.* Cleveland, U. S. A.
Jour. Am. Foundrymen's Assoc. *m.* New York.
Journal Asso. Eng. Societies. *m.* Philadelphia.
Journal of Electricity. *m.* San Francisco.
Journal Franklin Institute. *m.* Philadelphia.
Journal of Gas Lighting. *w.* London.
Journal Royal Inst. of Brit. Arch. *s-qr.* London.
Journal of Sanitary Institute. *qr.* London.
Journal of the Society of Arts. *w.* London.
Journal of U. S. Artillery *b-m.* Fort Monroe, U.S.A.
Journal Western Soc. of Eng. *b-m.* Chicago.
Journal of Worcester Poly. Inst., Worcester, U.S.A.
Locomotive. *m.* Hartford, U. S. A.
Locomotive Engineering. *m.* New York.
Machinery. *m.* London.
Machinery. *m.* New York.
Madrid Cientifico. *t-m.* Madrid.
Marine Engineering. *m.* New York.
Marine Review. *w.* Cleveland, U. S. A.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Metallographist. *qr.* Boston.
Metal Worker. *w.* New York.
Métallurgie. *w.* Paris.
Minero Mexicano. *w.* City of Mexico.
Minerva. *w.* Rome.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci Press. *w.* San Francisco.
Mining Reporter. *w.* Denver, U. S. A.
Mitt. aus d Kgl Tech. Versuchsanst. Berlin.
Mittheilungen des Vereines für die Förderung des Local und Strassenbahnwesens. *m.* Vienna.
Modern Machinery. *m.* Chicago.
Monatsschr. d Wurtt. Ver. f Baukunde. *m.* Stuttgart.
Moniteur Industriel. *w.* Paris.
Mouvement Maritime. *w.* Brussels.
Municipal Engineering. *m.* Indianapolis, U. S. A.
Municipal Journal and Engineer. *m.* New York.
Nature. *w.* London.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Nineteenth Century. *m.* London.
North American Review. *m.* New York.
Oest. Wochenschr. f. d. Oeff Baudienst. *w.* Vienna.
Oest. Zeitschr. Berg- & Hüttenwesen. *w.* Vienna.
Ores and Metals. *w.* Denver, U. S. A.
Pacific Coast Miner. *w.* San Francisco.
Page's Magazine. *m.* London.
Plumber and Decorator. *m.* London.
Popular Science Monthly. *m.* New York.
Power. *m.* New York.
Practical Engineer. *w.* London.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Pro. Canadian Soc. Civ. Engrs. *m.* Montreal.
Procedings Engineers' Club. *qr.* Philadelphia.
Pro. St. Louis R'Way Club. *m.* St. Louis, U. S. A.
Progressive Age. *s-m.* New York.
Quarry. *m.* London.
Queensland Gov. Mining Jour. *m.* Brisbane, Australia.
Railroad Gazette. *w.* New York.
Railway Age. *w.* Chicago.
Railway & Engineering Review. *w.* Chicago
Review of Reviews. *m.* London & New York.
Revista d Obras. Pub. *w.* Madrid.
Revista Tech. Ind. *m.* Barcelona.
Revue de Mécanique. *m.* Paris.
Revue Gen. des Chemins de Fer. *m.* Paris.
Revue Gen. des Sciences. *w.* Paris.
Revue Industrielle. *w.* Paris.
Revue Technique. *b-m.* Paris.
Revue Universelle des Mines. *m.* Liége.
Rivista Gen. d Ferrovie. *w.* Florence.
Rivista Marittima. *m.* Rome.
Schiffbau. *s-m.* Berlin.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Sibley Jour. of Mech. Engng. *m.* Ithaca, N. Y.
Stahl und Eisen. *s-m.* Düsseldorf.
Steam Engineering. *m.* Chicago.
Stevens' Institute Indicator. *qr.* Hoboken, U.S.A.
Stone. *m.* New York.
Street Railway Journal. *m.* New York.
Street Railway Review. *m.* Chicago.
Tijds. v h Kljk. Inst. v Ing. *qr.* Hague.
Traction and Transmission. *m.* London.
Tramway & Railway World. *m.* London.
Trans. Am. Ins. Electrical Eng. *m.* New York.
Trans. Am. Ins. of Mining. Eng. New York.
Trans. Am. Soc. Mech. Engineers. New York.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Transport. *w.* London.
Wiener Bauindustrie Zeitung. *w.* Vienna.
Yacht. *w.* Paris.
Zeitschr. d. Mitteleurop. Motorwagen Ver. *s-m.* Berlin.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschrift für Elektrochemie. *w.* Halle a S.
Zeitschr. f. Electrotechnik. *w.* Vienna.

CURRENT RECORD OF NEW BOOKS

NOTE—Our readers may order through us any book here mentioned, remitting the publisher's price as given in each notice. Checks, Drafts, and Post-Office Orders, home and foreign, should be made payable to THE ENGINEERING MAGAZINE.

Copper.

The Copper Handbook. A Manual of the Copper Industry of the World. Vol. III. By Horace J. Stevens. Size, 9 by 6 in.; pp. 600. Price, $5 (buckram); $7.50 (full morocco). Houghton, Mich.: Horace J. Stevens.

The previous edition of this work was a most valuable compilation of information about copper, but it is fairly excelled by the present volume. The latter has been strengthened by the addition of a considerable number of new statistical tables, and former tables, reprinted and brought down to date, have been consolidated in all cases possible, thus affecting a considerable saving in space. These tables are believed to give the most comprehensive copper statistics ever prepared for any work. The chapters devoted to the scientific features of the copper industry have been entirely rewritten and greatly amplified, while a number of new chapters have been added, the part of the book devoted to the history and the technical side of the copper industry being about twice the length of the similar section in the last annual issue. The major part of the book contains descriptions of 2,207 copper mines and copper mining companies in all parts of the world. These have been made as detailed as warranted by importance and permitted by the material secured. There are eight chapters filled with descriptions of the copper deposits in all countries, and others devoted to copper history, geology, chemistry, mineralogy, metallurgy, uses and statistics, so that the book is a high-grade mine of copper facts, and more than maintains the standard set by its predecessors.

Motormen.

How to Become a Competent Motorman. By Virgil B. Livermore and James Williams. Size, 6 by 4 in.; pp. 232; illustrations and diagrams. Price, $1. New York: D. Van Nostrand Company.

The large electric railway companies find it advisable to maintain regular schools of instruction for motormen, and as a general rule, no man should be allowed to run an electric car without having had a thorough course of coaching. But he may get some serviceable knowledge from books, and it is the object of the present work to instruct motormen in the proper handling of the different equipments now being used by electric railways. There are descriptions of motors, brakes and other apparatus and their methods of operation, but the main part of the book is devoted to the controller, some of the leading types of which are shown by illustration and diagram. The arrangement of matter might be more systematic, and the diction is rather crude in places, but the book contains some good practical advice, is in convenient shape, and will no doubt be useful to the elecric railway man.

Tools.

Modern Machine Shop Tools. Their Construction, Operation, and Manipulation, including both Hand and Machine Tools. By William H. Van Dervoort, M. E. Size, 9¼ by 6 in.; pp. 552; figures, 672. Price, $4. New York: Norman W. Henley & Co.

In order to become a competent machinist, practical experience in the shop is absolutely necessary, but a very good general idea of the construction and operation of tools may be obtained from books, and by thus getting a systematic knowledge of machinery, the young apprentice can make much more rapid and orderly progress than if he relied merely upon what haphazard verbal instruction he could obtain. And if one desires to become anything more than a handicraftsman, the wider view obtained by study is essential. The present book will supply this knowledge, and give this broader view of the machine shop and the tools and appliances used therein. It is an outgrowth of a series of articles prepared by the author for the students in machine-shop practice at the University of Illinois, and is logically arranged, the various hand and machine tools being grouped into classes, and the description of each tool or machine being in accordance with its importance. It is a book of practical instruction, written with a full appreciation of the influence of modern manufacturing shop methods upon the training of young mechanics.

NEWS SUPPLEMENT

The Engineering Magazine—July, 1903

Coming Society Meetings.

AMERICAN BOILER MANUFACTURERS' ASSOCIATION. Sec.: J. D. Farasey, Cleveland. Next meeting July, at Chattanooga.

AMERICAN INSTITUTE OF ELETRICAL ENGINEERS. Sec.: Ralph W. Pope, 95 Liberty St., New York. Annual convention, June 29-July 3, Niagara Falls. Regular meeting on fourth Friday of each month, except June, July and August, 12 W. 31st St., New York.

AMERICAN INSTITUTE OF MINING ENGINEERS. Sec.: R. W. Raymond, 99 John St., New York. Next meeting, October, at New York.

AMERICAN PARK AND OUTDOOR ART ASSOCIATION. Sec.: C. M. Robinson, Rochester, N. Y. Annual meeting, July 7-9, at Buffalo.

AMERICAN RAILWAY ASSOCIATION. Sec.: W. F. Allen, 24 Park Place, New York. Next meeting Oct. 28, at Richmond, Va.

AMERICAN RAILWAY MECHANICAL AND ELECTRICAL ASSOCIATION. Sec.: Walter Mower, Detroit. First annual meeting, Sept. 1-4, Saratoga Springs, N. Y.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Sec.: C. W. Hunt, 220 W. 57th St., New York. Regular meetings, first and third Wednesdays of each month, except July and August.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS. Sec.: W. M. Mackay, P. O. Box 1818, New York. Annual convention, July 17 and 18, at Niagara Falls.

AMERICAN SOCIETY FOR TESTING MATERIALS. Sec.: Prof. Edgar Marburg, University of Pennsylvania. Convention July 1, 2 and 3, at Delaware Water Gap.

AMERICAN STREET RAILWAY ASSOCIATION. Sec.: T. C. Penington, 2020 State St., Chicago. Annual meeting, Sept. 2-4, Saratoga Springs, N. Y.

ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS. Sec.: S. F. Paterson, Concord, N. H. Annual convention, Oct. 20, Quebec.

BOSTON SOCIETY OF CIVIL ENGINEERS. Sec.: S. E. Tinkham, 715 Tremont Temple. Regular meetings on third Wednesday of each month, except July and August.

CANADIAN RAILWAY CLUB. Sec.; W. H. Rosevear, Jr., Montreal. Regular meetings on first Tuesday of each month, except June, July and August.

CANADIAN SOCIETY OF CIVIL ENGINEERS Sec.: Prof. C. H. McLeod, 877 Dorchester St. Montreal. Regular meetings every alternate Thursday, from October to May, inclusive.

CENTRAL RAILWAY CLUB. Sec.: Harry D. Vought, 62 Liberty St., New York, Regular meetings on second Fridays of Jan., March, May, Sept. and Nov., Hotel Iroquois, Buffalo.

CHICAGO ELECTRICAL ASSOCIATION. Sec.: W. J. Warder, Jr., 900 Warren Ave. Regular meetings on first Friday of each month, from October to May.

CIVIL ENGINEERS' CLUB OF CLEVELAND. Sec.: Arthur A. Skeels, 689 The Arcade. Regular meetings on second and fourth Tuesdays of each month.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL. Sec.: G. S. Edmondstone. Regular meetings on second Monday of each month.

ENGINEERING ASSOCIATION OF THE SOUTH. Sec.: Robt. L. Lund, 2102 Hayes St., Nashville, Tenn. Regular meetings on second Thursday of each month at the Berry Block.

ENGINEERS' CLUB OF CHICAGO. Sec.: B. W. Thurtell, 1223 New York Life Building. Regular meetings on first and third Tuesdays of each month.

ENGINEERS' CLUB OF CINCINNATI. Sec.: J. F. Wilson, P. O. Box 333. Regular meetings on third Saturday of each month, except July and August.

ENGINEERS' CLUB OF COLUMBUS (OHIO). Sec.: H. M. Gates, 12½ North High St. Regular meetings on third Saturday of each month, except July and August.

ENGINEERS' CLUB OF MINNEAPOLIS. Sec.: Edw. P. Burch, 1210 Guaranty Bldg. Regular meetings on third Mondays.

ENGINEERS' CLUB OF PHILADELPHIA. Sec.: J. O. Clarke, 1122 Girard Street. Regular meetings on first and third Saturdays of each month, except July and Aug.

ENGINEERS' CLUB OF ST. LOUIS. Sec.: H. J. Pfeifer, 920 Rialto Bldg. Regular meetings on first and third Wednesdays of each month.

ENGINEERS' SOCIETY OF WESTERN NEW YORK. Sec.: L. W. Eighmy, 13 City Hall, Buffalo. Regular meetings, first Tuesday of each month, except July and August.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA. Sec.: Chas. W. Ridinger, 410 Penn. Ave., Pittsburg. Regular meetings on third Tuesday of each month.

FRANKLIN INSTITUTE. Sec.: Dr. Wm. H. Wahl, 15 South 7th St., Philadelphia. General meetings on third Wednesday of each month, except July and August. Regular monthly meetings of the various sections on other days.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Sec.: Frank P. Foster, Corning, N. Y. Meeting, September 2-4, Atlantic City, N. J.

IOWA RAILWAY CLUB. Sec.: P. B. Vermillion, Des Moines, Iowa. Regular meetings on third Tuesday of each month.

LEAGUE OF AMERICAN MUNICIPALITIES. Sec.: John MacVicar, Des Moines, Iowa. Seventh annual convention, Oct. 7-9, at Baltimore.

LOUISIANA ENGINEERING SOCIETY. Sec.: G. W. Lawes, 806 Gravier St., New Orleans. Regular meetings on second Monday of each month.

MASTER CAR BUILDERS' ASSOCIATION. Sec.: J. W. Taylor, 667 Rookery, Chicago. Meeting, June 29 to July 1, Saratoga Springs, N. Y.

MODERN SCIENCE CLUB. Sec.: R. Henderson, 302 Livingston St., Brooklyn. Meetings every Tuesday.

MONTANA SOCIETY OF ENGINEERS. Sec.: Richard R. Vail, Butte, Mont. Regular meetings on second Saturday in each month.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Sec.: W. H. Morton, Utica, N. Y. Next meeting, July 14-17, at Detroit.

NEW ENGLAND RAILROAD CLUB. Sec.: Edw. L. Janes, Back Bay P. O., Boston. Regular meetings, second Tuesday in each month, except June, July, August and September, at Pierce Hall, Copley Square.

NEW YORK ELECTRICAL SOCIETY. Sec.: Geo. H. Guy, 114 Liberty St., New York. Meetings monthly, on different Wednesdays.

NEW YORK RAILROAD CLUB. Sec.: F. M. Whyte, Grand Central Station, N. Y. City. Regular meetings on third Friday of each month, except June, July and August, at Carnegie Hall, 154 W. 57th St., New York.

NORTH-WEST RAILWAY CLUB.. Sec.: T. W. Flannagan, Minneapolis, Minn. Regular meetings on first Tuesday after second Monday of each month, except June, July and August, alternating between Minneapolis and St. Paul.

PACIFIC COAST RAILWAY CLUB. Sec.: C. C. Borton, West Oakland, Cal. Regular meetings on third Saturday of each month at different cities.

PACIFIC NORTHWEST SOCIETY OF ENGINEERS. Sec.: G. F. Cotterill, Seattle, Wash. Meetings monthly in Chamber of Commerce rooms, Seattle.

RAILWAY CLUB OF PITTSBURG. Sec.: J. D. Conway, P. & L. E. R. R., Pittsburg, Pa. Regular meetings on fourth Friday of each month, except June, July and August, at Hotel Henry.

RAILWAY SIGNALING CLUB. Sec.: B. B. Adams, 83 Fulton St., New York. Regular meetings on second Tuesday of January, March, May, Sept. and Nov. Annual meeting, Nov. 10, at Detroit.

RICHMOND RAILROAD CLUB. Sec.: F. O. Robinson, 8th & Main Sts., Richmond, Va. Regular meetings on second Thursday of each month, except June, July and August.

ROADMASTERS AND MAINTENANCE OF WAY ASSOCIATION. Sec.: Chas. McEniry, Cedar Rapids, Iowa. Annual meeting, Oct. 13, 14 and 15, at Kansas City, Mo.

ROCKY MOUNTAIN RAILWAY CLUB. Sec.: J. E. Buell, 906 20th Ave., Denver. Regular meetings on first Saturday after the 15th of each month.

ST. LOUIS RAILWAY CLUB. Sec.: E. A. Chenery, Union Station, St. Louis. Regular meetings on second Friday of each month, except July and August.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Sec.: C. A. Waldo, Purdue University, Lafayette, Ind. Annual convention, July 1-3, at Niagara Falls.

SOCIETY OF CHEMICAL INDUSTRY, NEW YORK SECTION. Sec.: H. Schweitzer, 40 Stone St. Meetings on third Friday after the first Monday of each month, at Chemists' Club, 108 W. 55th St.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB. Sec.: W. A. Love, Atlanta, Ga. Regular meetings on third Thursday of Jan., April, Aug. and Nov.

TECHNICAL SOCIETY OF THE PACIFIC COAST. Sec.: Otto von Geldern, 31 Post St., San Francisco. Regular meetings on first Friday of each month.

TEXAS RAILWAY CLUB. Sec.: T. H. Osborne, Pine Bluff, Ark. Regular meetings on third Monday of April and September.

TRAVELING ENGINEERS' ASSOCIATION. Sec.: W. O. Thompson, Oswego, N. Y. Next meeting, Sept. 8, Chicago.

WESTERN RAILWAY CLUB. Sec.: Jos. W. Taylor, 667 Rookery, Chicago. Meetings on third Tuesday of each month, except June, July and August, Auditorium Hotel, Chicago.

WESTERN SOCIETY OF ENGINEERS. Sec.: J. H. Warder, Monadnock Block, Chicago. Regular meetings on first Wednesday and extra meetings on third Wednesday of each month, except July and August.

Personal.

—Mr. Charles F. Scott, president of the American Institute of Electrical Engineers, delivered an address to the graduating class at the commencement exercises of Stevens Institute of Technology.

—Mr. R. Van Dorn, formerly with the Struthers-Wells Co., is now general sales manager of the Titusville Iron Co., founders, machinists and boiler makers, of Titusville, Pa.

—Mr. William Burlingham has accepted an appointment as chief engine designer with the B. F. Sturtevant Co., of Hyde Park, Mass., resigning a position in the United States Inspection Office with the Wm. R. Trigg Co., of Richmond, Virginia.

Mr. Burlingham has previously been associated with the Bath Iron Works, the General Electric Co., the Southwark Machine & Foundry Co., and the Newport News Ship-Building & Dry Dock Co. He has also served on Edison's staff at the Orange Laboratory, and is a graduate of the Worcester Polytechnic Institute.

—Mr. H. E. Maxfield, formerly resident agent for Lawrence Centrifugal Pumps, 39-41 Cortlandt Street, will hereafter be known under the firm name of H. E. Maxfield & Co., with offices at No. 136 Liberty Street, New York, where all inquiries received for centrifugal pumping machinery, house pumps, hoisting engines and general machinery, will be given prompt attention.

—Mr. Henry R. Cornelius, of Pittsburg, for so many years direct representative of the Southwark Foundry & Machine Co., of Philadelphia, has taken entire charge of the output of the Brown Corliss Engine Co., in the Pittsburg district. He has opened up new offices in the Frick Building, and being so well posted in this territory, should be a very valuable acquisition to the already progressive Brown Corliss Engine Co. Mr. Cornelius has spent a great deal of time in the mills and works at Pittsburg, and is considered one of the best authorities on rolling-mill and blowing engines.

—Mr. E. O. Edson has been elected secretary and treasurer of the Bendit Mercantile Engineering Co., of St. Louis, successors to Laufketter-Bendit Mercantile Enginering Co.

Industrial Notes.

A VERY entertaining little booklet, entitled "New York to Newfoundland—Thirteen Days on the Steamer," by Miss Marion Varian, associate editor of *Compressed Air*, has been issued in attractive form, with a cover in colors, decorated with the American and British flags crossed. The booklet is written in a fresh, breezy style and gives a bright picture of a pleasant trip which took the voyagers down Long Island Sound, past Nantucket, out to sea and across to Nova Scotia and Newfoundland, and included stops at Halifax, St. John, and Sydney. The course after leaving Halifax, on the return trip, was the same as on the outward voyage. There are illustrations of the ship and of the various places visited, made from photographs taken by the author, and the booklet, while being an excellent advertisement for the steamship company, makes a delightful little story on its own account. The author intends to take similar trips during her summer vacations, either by water or on land, and will write them up in the same attractive style, which cannot fail to be of material benefit to the steamship lines and railroads which are favored with her patronage.

—Among the recent sales of the Reeves Engine Co., are two large cross-compound vertical direct-connected engines for the new city lighting plant at Bluffton, Indiana, as well as several direct-connected engines for the Bullock Electric Manufacturing Company, some of which are for export. The works of the Reeves Engine Co. are running night and day with two shifts of men, in their efforts to catch up with the orders they are receiving.

—One of the biggest summer resorts within easy reach of civilization, is what is commonly termed Muskoka, a district in the "Highlands of Ontario" about 100 miles north of Toronto, including an immense tract of country bordering on the Georgian Bay. This district is composed of lakes and rivers innumerable and is situated 1,000 feet above sea level. Good fishing and hunting are assured. Ample hotel accommodation at all points on the lakes is provided to suit the purses of everyone. There is excellent transportation service furnished by the Grand Trunk Railway. Copies of handsome, descriptive literature relating to this country can be had free by applying to F. P. Dwyer, Eastern Passenger Agent of the Grand Trunk Railway System, 290 Broadway, New York.

—The Allis-Chalmers Co. have recently made some large engine sales to a number of customers, including the St. Louis Exposition, the National Tube Co., the Kansas City Water Works and others.

—Westinghouse, Church, Kerr & Co., have recently sold additional train-lighting equipments to the Chicago, Milwaukee & St. Paul, and the Northern Pacific Railway Co., for service on their Special Limited trains. The outfit consists of a 25 or 30-horse-power Westinghouse standard vertical single-acting engine, direct connected

to a direct-current generator of corresponding capacity. The units are extraordinarily compact and are located in the front part of the baggage car, which location is favorable for supplying high-pressure steam directly from the locomotive boiler through flexible piping. The direct-connected steam-driven unit possesses many advantages for train-lighting service, and the majority of troubles, incident to the use of other types of apparatus for this service, are avoided. The system is now in use on a large number of roads in this country, including the Chicago & Northwestern, Union Pacific, Lake Shore & Michigan Southern, and Duluth South Shore & Atlantic.

—The Shepherd Engineering Company, manufacturers of the Shepherd steam engines, will, after July 1st, have their general offices and works at Franklin, Pa., where they have secured for the manufacture of their product the large and modern plant constructed a few years ago by the Grant Tool Company. This plant will enable the Shepherd Engineering Company to take care of its greatly increased business, and will also enable them to make prompt deliveries on future work.

—The legislature of Michigan has passed a bill appropriating $171,900 for the Michigan College of Mines, at Houghton, for the biennium beginning July 1st. The most important item of this appropriation is that of $45,000 for the construction of a metallurgical laboratory. The college intends to erect a substantial building for this purpose, and to thoroughly equip it for experimental work and instruction in the different classes of metallurgical processes. Cyaniding and other wet methods of concentration will be exemplified in the equipment and electrometallurgy will receive special attention. It is intended to install furnaces of larger capacity than is usual in college laboratories. The board of control of the college is taking steps to create a separate department of ore dressing and metallurgy. The equipment for this department will be housed in the new metallurgical building and in the ore dressing mill now possessed by the college. A man to fill the new chair has not been selected. Beside the amount for a metallurgical laboratory, the bill referred to carries an appropriation of $9,000 for extending the equipment of the department of mining engineering, which now occupies its new building erected last year; $4,000 for completing the equipment of the chemistry building, also erected last year; $2,000 for providing additional cases for the mineralogical museum; and $1,000 for increasing the equipment of the department of mechanical engineering.

—In a plant recently installed in the South by the Pneumatic Engineering Company, 128 Broadway, New York, the air lift system pumps nine million gallons of water per day from four 10-inch wells.

—The Buffalo Steam Pump Company, whose works are at North Tonawanda, has been purchased by Messrs. William F. and Henry W. Wendt, who are also owners of the Buffalo Forge Company and the Geo. L. Squier Manufacturing Company. The North Tonawanda Works of the Steam Pump Co. are to be retained as heretofore, and the main offices will be in Buffalo.

—The steamship "Roseley," which left New York recently for various South African ports, took out what will probably be the first electric locomotive to enter the "Dark Continent." The locomotive, which was manufactured by the C. W. Hunt Company, of West New Brighton, Staten Island, N. Y., is shipped to the order of the DeBeers Consolidated Mines, Ltd., the most powerful mining syndicate in South Africa, for use on one of their plants. The locomotive is of the latest storage-battery type, standard throughout, with the exception of the gauge of the wheels, which is special, to suit the track now in use at the mines.

—The Hancock Inspirator Co., of New York, have received a letter from Mr. W. W. Henry, of Homochitto, Miss., in which he says: "We are using for feeding a boiler one of your inspirators that has been in use about 18 years, and it never gives us a minute's trouble. We work it under all steam pressures from 25 to 140 pounds. I do not believe this can be beaten."

—The Lagonda Manufacturing Co., of Springfield, Ohio, report that the month of May was the best they have ever had since they commenced the manufacture of their tube cleaners. The demand for these machines seems to be growing right along. The Lagonda Co. have been crowded out of the factory which they have been occupying for the past year and have just built a fact-

ory of their own which is greatly enlarged, and have equipped it throughout with special tools and machinery adapted for the particular work which they have to do, but even in their new quarters, they are compelled to run overtime in order to keep up with the demand made upon them for machines. This encouraging state of affairs is due largely to the fact that Mr. Weinland is a practical engineer and understands exactly what is needed in the way of a cleaner for removing scale. His knowledge and experience has enabled him to produce a boiler-tube cleaner which is not only a rapid worker, but is strong and durable.

—The Titusville Iron Company have recently completed what is probably one of the largest boiler shops in the country, it being one room 200 feet in width and 425 feet in length, consisting of four 50-foot bays, each of which is equipped with an electric crane of suitable capacity running the full length of the building. Across one end of the building extends the railroad track, upon which railroad cars are run into the works and loaded or unloaded under either of the cranes as desired. A large number of new tools have been recently purchased in addition to the efficient equipment already operated by the company, which have enjoyed a very desirable trade in horizontal tubular boilers and all classes of sheet-iron and heavy-plate work, and with the present enlarged works and equipment expect at least to triple their former output.

—The Peabody Coal Co., of Chicago, have issued a second edition of their large wall map, showing the location of the coal mines in the States of Illinois and Indiana, together with a book of statistics on this subject, including the shipping mines and coal railroads of these states, names of operators, railway connections, coal washing plants, etc., all of which makes a very useful and convenient work of reference.

—The R. B. Carter Co., of 26 Cortlandt St., New York, who are sales agents for G. M. Davis & Son, of Palatka, Florida, manufacturers of cypress wood tanks, tubs, vats, covers and gauges, have issued a handy little case filled with pins, entitled "A Few Pointers on Cypress Tanks."

—The American Diamond Rock Drill Company have recently sold several diamond drills to the Argentine Government. The Government of the Argentine Republic having decided to develop and prospect their mineral lands by means of the diamond drill, sent out an engineer to act in their interest, and to examine all existing machines and methods of boring. After a tour through France, Germany, England and the United States, which included a thorough and complete examination of all machines manufactured, the order was given to the American Diamond Rock Drill Company, who have now supplied the machines.

—The American Blower Co., of Detroit, report business excellent in all of their lines. Among the larger orders recently received they mention heating and induced-draft apparatus for the Ironton (O.) Engine Co.; drying outfits for the Illinois Sugar Refining Co., to be installed at Pekin, Ill.; and the Michigan Starch Co., to be used in their Travers City plant; dry kilns for the Mengel Box Co., of Louisville, Ky.; Brooklyn Cooperage Co., of New York; Buckstege Furniture Co., Evansville, Ind.; Evansville, (Ind.) Desk Co.; Cadillac Cabinet Co., Detroit, and many others.

—The Philadelphia Pneumatic Tool Co., in order to take care of their largely increased business in the middle west, have employed Mr. J. F. Ahern, formerly with the Scully Steel & Iron Co., to assist Mr. A. G. Hollingshead, western sales manager for the Philadelphia Company. This company has also appointed Mr. H. B. Griner, late assistant manager of the Chicago Pneumatic Tool Co., to a position in the main office of the Philadelphia Pneumatic Tool Co. This company reports large orders for chipping hammers, riveters and drills from the Craig Shipbuilding Co., Toledo; Willamette Iron and Steel Co., Portland, Oregon; Kewanee Boiler Works, United Gas Improvement Co.; J. D. Connell Iron Works, New Orleans; Chandler & Taylor Co.; Allis-Chalmers Co.; and others.

—Tests made by Mr. C. W. Weiss at the Mietz & Weiss engine works, 128-138 Mott street, New York City, with Cuban and Brazilian cheap alcohol as fuel in their standard kerosene engine, have been reported as entirely satisfactory. The object was to substitute alcohol for kerosene; the former being considerably cheaper and more readily obtainable in Cuba and South Amer-

ica, whither many of these engines are being exported. It was found that a mixture of four pints of alcohol and two pints of water developed 4 horse power for one hour. The mixture of alcohol and water varies, however, with the quality of the former, being limited by the practical degree of compression prior to combustion. The specific gravity of the mixture is .9; the pure alcohol was .794. The development of the alcohol engine is of the greatest importance to the power question of Cuba, Brazil and the Philippine Islands.

—The Nernst Lamp Company, of Pittsburg, has established a Maintenance Bureau for the purpose of supplying users of Nernst lamps with new burners or holders, so it will not be necessary for the customer to visit or call upon the electric light stations when one of his lamps gives out. The Maintenance Bureau makes a contract to supply to its customers a certain number of extra holders which are kept in a box especially made for this purpose. The customer simply takes one of these extra holders and replaces the old one with it, returning the old holder to the box, which is called for by a messenger attached to the Maintenance Bureau. This messenger takes the burned-out holders to the Bureau and they are refilled and returned to the customer. The taking out and putting in of these holders is as easily accomplished as the changing of incandescent lamps. By this method, the users of Nernst lamps are not put to the inconvenience of notifying the electric light company when the lamp gives out: thus avoiding the necessary delay in having their lamps renewed.

—The American Stoker Company has changed the location of its general offices from New York City to Erie, Pennsylvania, where its stokers are manufactured. This will bring the operating department in closest contact with the manufacturing, and secure even better results in the handling of business. Mr. J. S. Van Cleve, president of the Erie Foundry Company, also becomes general manager of this company, and Mr. Herbert D. Lloyd, vice-president and treasurer. All correspondence should be addressed to the company at Erie, Pa.

—The Harrison Safety Boiler Works announce a change in their sales department, whereby Mr. J. M. Dashiell, who has represented them in New England under the title of the Dashiell Engineering Company, 1103 Paddock Building, Boston, is now placed in charge of their Baltimore section. Their New England office will be continued at the above address under the title of the Harrison Safety Boiler Works, with Mr. John Hickey as their representative.

—The Cost-System and Auditing Company, of New York, makes a specialty of designing and installing factory cost-systems, and so connecting them with the general accounts of a business that a monthly profit and loss account and balance sheet may be easily prepared without taking an inventory by count. Many of the features of the system installed by it are unique, and under it most accurate results are obtained and guess work is entirely eliminated. The fact that this company is conducted by certified public accountants of the State of New York, insures reliability and efficiency, and its president, H. F. Searle, C. P. A., and treasurer, H. C. Maass, C. P. A., have become well known throughout the country as experts in this line of work. Its offices are at 45 Broadway, New York.

—The Alberger Condenser Co., 95 Liberty Street, New York, has acquired control of the Newburgh Ice Machine & Engine Co., Newburgh, N. Y. This engine company has been long and favorably known as a builder of Corliss engines, ice machines and similar high class machinery. It is understood to be the intention of the Alberger Condenser Co. to devote this works principally to the manufacture of improved condensers, vacuum pumps and Corliss pumping machinery, which it is using extensively in connection with high-vacuum condenser installments. The recent developments in this class of work all tend toward the improvement of the parts that make up the condensing equipment. This has been largely brought about by the demand for an extremely high vacuum in connection with steam turbines and the inability of the old types of apparatus to accomplish the results required in an efficient manner. The Alberger Condenser Co. still retains close connection with the Quintard Iron Works, of New York City, but rapidly increasing business has made it necessary to obtain additional facilities for the manufacture of special lines of work.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Chemicals.

Circulars Nos. 168 and 169, with descriptions and price lists of many kinds of chemicals for a great variety of purposes. 12 by 9 in.; pp. 4. The Roessler and Hasslacher Chemical Co., 100 William St., New York.

Coal Handling Machinery.

Catalogue, with illustrations and descriptions of hoisting engines, steam shovels or automatic buckets, revolving screens, cars, sheaves, chains, rails, and other appliances, and of many complete coal-handling plants in active operation. 9¼ by 6¼ in.; pp. 72. George Haiss Mfg. Co., 141st St. and Rider Ave., New York.

Condensers.

Book, with descriptions and illustrations of Wheeler condensers, feed-water heaters, evaporators, centrifugal pumps, and vacuum pans and multiple effects for sugar making, the Volz combined condenser and feed-water heater, the Barnard-Wheeler water cooling towers, and other kinds of condensing and steam engineering apparatus. 6 by 9¼ in.; pp. 120. Wheeler Condenser and Engineering Co., 120 Liberty St., New York.

Cotton Machinery.

Catalogue, in handsomely-designed covers, with well illustrated descriptions of modern high-grade cotton machinery for elevating, cleaning, ginning and pressing cotton, and for blowing and sacking cotton seed. 8 by 10 in.; pp. 58. Thomas-Fordyce Mfg. Co., Little Rock, Ark.

Disc Grinder.

A booklet, with illustration and description of disc grinders having steel discs covered with emery paper, for grinding flat surfaces, and examples of the kind of work a disc grinder will do, and the short time it takes to do it. 6 by 3½ in.; pp. 8. Bayldon Machine and Tool Co., Jersey City, N. J.

Dynamos.

Bulletin No. 30, with illustrations and descriptions of direct-current generators of various types, including some very compact twin generators for connection to steam turbines, their parts and accessories. 10 by 7 in.; pp. 32. Northern Electrical Mfg. Co., Madison, Wis.

Electric Driving.

Brochure, with half-tone illustrations and descriptive text, showing some typical examples of the latest engineering practice in the application of electric motors to machine tools and various other kinds of mechanical devices, and demonstrating the great convenience and flexibility of individual motor driving. 9½ by 6¼ in.; pp. 22. Holtzer-Cabot Electric Co., Boston (Brookline), Mass.

Electric Fans.

Catalogue No. 306, with illustrations, descriptions and prices of Lundell electric fans and their parts, of the desk, ceiling, exhaust and various other types. Also, telegraph code. 9¼ by 7 in.; pp. 20. Sprague Electric Co., New York.

Electric Mining.

"Industrial Series" pamphlet No. 13,000, devoted to "Electricity in Mining," and giving illustrated descriptions of the application of electricity to haulage, hoisting, pumping and air compressing, ventilation, drilling and coal cutting, lighting, gold dredging and other mining operations. 9 by 6 in.; pp. 31. Westinghouse Electric and Manufacturing Co., Pittsburg.

Engine Stop.

A unique pamphlet, with illustrations and descriptions of the Monarch engine-stop and speed-limit systems and the Monarch motor stop, and their operation when stopping machinery in case of accident; with many testimonials. 9½ by 3 in.; pp. 16. The Consolidated Engine-Stop Co., 100 Broadway, New York.

Foundry Supplies.

Complete catalogue and price list No. 36, fully illustrated, of foundry facings and blackings, plumbago, silver and black lead, molders' tools and all other kinds of supplies for iron, brass and steel foundries, pattern makers, machinists, rolling mills, furnaces and steel works. 7¼ by 5¼ in.; pp. 320. The J. D. Smith Foundry Supply Co., Cleveland.

Hydraulic Machinery.

Catalogue No. 65, an illustrated index of hydraulic jacks, punches, shears, presses, pumps, riveters, valves and other kinds of hydraulic tools and machinery, full and complete descriptions of which, on separate sheets, will be furnished on request. 9 by 6 in.; pp. 83. The Watson-Stillman Co., 204-210 East 43rd St., New York.

Locomotives.

Record of Recent Construction No. 42, containing "A Study of the Steam Distribution of the Vauclain Compound Locomotive," by Lawford H. Fry, with illustrations in the text and a sheet of diagrams. 6 by 9 in. pp. 16. Baldwin Locomotive Works, Philadelphia.

Machine Tools.

Machinery "blue book" for 1903, cloth-bound, with concise, but complete, descriptions and half-tone illustrations of lathes, planers, drills, milling machines, gear cutters, shapers, grinders, and many other kinds of high-grade modern machine tools. 9¼ by 6¼ in.; pp. 118. Hill, Clarke & Co., Boston.

Milling Machines.

Pamphlet on "Examples of Rapid Milling," with illustrations and descriptions of a variety of interesting milling operations taken from actual practice and showing the class of work for which Cincinnati geared-feed millers are adapted, and the high rate at which they are operated. 9 by 6 in.; pp. 32. The Cincinnati Milling Machine Co., Cincinnati.

Ore Mills.

Pamphlet, with illustrations and descriptions of the Merralls "tension" quartz mill, built on the Chili principle, the Merralls rapid-crushing stamp mill, and other machinery for crushing and working gold and other ores in a rapid and economical manner. 10 by 6 in.; pp. 10. Merralls Mill Co., San Francisco.

Paints.

Catalogue, with artistic illustrations and descriptions of preservative paints for a variety of purposes, building papers, ready roofing, Malthoid roofing, electrical compound, armature varnish, insulating tape, asphalt saturated felt, asphalt for roofing and waterproofing purposes, and other of the well-known P. & B. products. 7 by 5 in.; pp. 24. Also, booklets devoted to these goods. The Paraffine Paint Co., San Francisco.

Pneumatic Tools.

Special circulars, Nos. 38 and 39, illustrating and describing pneumatic riveters, drills and various other types of pneumatic appliances, with views showing the tools at work. Circular No. 38 illustrates special applications of the jam riveter and the Boyer drill. 12¼ by 9½ in.; pp. 4. Chicago Pneumatic Tool Co., Chicago.

Folder, devoted to Keller pneumatic tools for riveting, chipping, ramming, drilling and other purposes. 10 by 4 in.; pp. 4. Philadelphia Pneumatic Tool Co., Philadelphia.

Rail Joint.

Catalogue No. 100, entitled "Kinks," with an illustrated description of the Q & C-Bonzano rail joint, and giving an account of its many excellent points and the reasons therefor. Also, a list of the railroads on which it is used. 9 by 6 in.; pp. 16. The Railway Appliances Company, Chicago.

Speed Change.

Circular, with illustrated description and price list of the "transformed cone pulley" speed change for driving all kinds of machinery. Also catalogue with illustrations, descriptions and price list of friction clutch pulleys, cut-off couplings and other power-transmission apparatus, and sheet with diagrams and tables of friction clutches and shafting. The Moore & White Co., Philadelphia.

Steam Engines.

Catalogue, with illustrations and descriptions of the "20th Century" heavy duty Corliss engine and other kinds of high grade steam engines and their parts and accessories, and Corliss air and gas compressors. 6 by 9 in.; pp. 24. The Lane & Bodley Co., Cincinnati.

Steam Turbines.

Bulletin No. 8, containing an illustrated paper by Privy Councilor Wichert, read before the German Engineers' Convention, on train lighting with De Laval steam turbines operating dynamos on German railways, and also views of De Laval train-lighting sets on American roads. 9 by 6 in.; pp. 32. De Laval Steam Turbine Co., 74 Cortlandt St., New York.

Tools.

Catalogue No. 17, with descriptions and illustrations of rules, tapes, squares, micrometers, gauges, clamps, test indicators, speed indicators, calipers, dividers, patent nail holder and set, screw drivers, levels and other kinds of fine mechanical tools, together with useful tables and data. 7½ by 5 in.; pp. 176. The L. S. Starrett Company, Athol, Mass.

Booklet, with illustrated descriptions of four-spindle turret drill, handy vises, universal joints, countershafts and other tools and machinery for the shop. 3½ by 5½ in.; pp. 12. Vanderbeck Tool Works, Hartford, Conn.

Turbines.

Circular, illustrating special design horizontal turbine water wheels used in the 50,000-horse-power plant of the Michigan Lake Superior Power Co. at Sault Ste. Marie, with results of tests. 9 by 6 in.; pp. 4. The Webster, Camp & Lane Co., Akron, O.

Universal Joint.

Folder, with illustrations and description of Bocorselski's patent universal joint, especially adapted for a flexible connection with the least possible friction. 9 by 6 in.; pp. 4. Bausch Machine Tool Co., Springfield, Mass.

Ventilators.

A pamphlet, with illustrations and descriptions of the Pullman automatic ventilator and its application to office buildings, schools, churches, hospitals, railway and street cars, residences and miscellaneous buildings. This ventilator is placed in the lower sash rail, or just underneath it, and provides an ample supply of pure air with proper diffusion and without drafts. 8 by 5 in.; pp. 32. Pullman Automatic Ventilator Co., 213 Produce Exchange, New York.

Wire Rope.

Catalogue No. 24, with illustrations, descriptions and prices of patent flattened-strand and other kinds of wire rope, hooks, blocks, sheaves, and other fittings and apparatus for wire-rope and cableway work; and also illustrated description of the Leschen Co.'s patent automatic aerial wire-rope tramway. 6 by 3½ in.; pp. 80. A. Leschen & Sons Rope Co., St. Louis.

Wire-Rope Haulage.

Large pamphlet, with handsome half-tone illustrations and diagrams, containing an account of underground wire-rope haulage, as successfully applied in the workings of the Coal Valley Mining Company at Sherrard and Cable, Illinois. 12½ by 9½ in.; pp. 24. The Broderick & Bascom Rope Co., St. Louis.

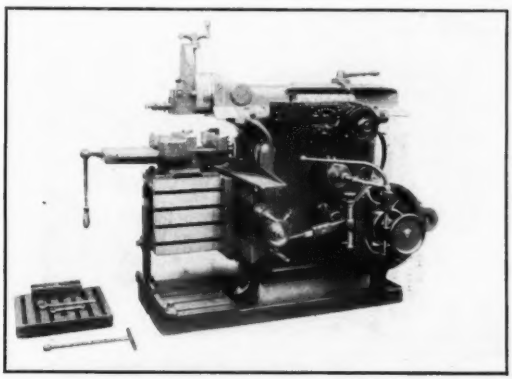
IMPROVED MACHINERY

New Processes and New Appliances

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

Eberhardt's Modern "High-Duty" Shaper.

WHAT may be termed the "new machine shop practice," including the modern betterments of thorough factory organization, the use of the new "high-duty" tool steels, and the accurate recording of successive similar operation time expenditures, is said in a certain instance to have reduced the finishing labor costs per pound as much as 30 per cent., although the shop in which this very large gain was made was at the start a thoroughly well equipped establishment.



GOULD & EBERHARDT HIGH-DUTY SHAPER.

The shaper has been allowed, by most builders of machine tools, to remain in nearly the same general form and possessed of the same metal removing powers for a long period of time, during which some improvements were made in the way of certainty of measurement in tool setting, but no very great advance in quickness of handling possibilities, or range of cutting speeds was even so much as attempted by any shaper manufacturer until Messrs. Gould & Eberhardt began their late series of shaper improvements, which involve almost every detail of tools of this class, and have finally resulted in the perfected electric-motor-driven, "double triple quick stroke" shaper shown in the accompanying illustration, which has easily the most flexibility of drive, and the most convenient series of speed change producing devices ever offered to purchasers in any mechanical tool whatever. Messrs. Gould & Eberhardt are advocates of individual motor application to machine tool driving, claiming that it has decided advantage over the grouping of several machines and driving them with one motor. As a strong argument in favor of their advocacy of the single motor drive they cite the advantages embodied in their new shaper, the arrangement of which permits of the speed being instantly changed to suit the metal being worked, which would not be possible if the machine was one of a group, where any change in the speed of the motor would affect the speed of all of the machines in the group.

This new "quick change" shaper combines its greatly increased range of speeds with highly beneficial improvements in knee support, and has all of its operating handles brought within easy reach of the workman, and also makes some important details, formerly requiring intelligent hand adjust-

ment, automatic in operation. This convenient location of levers and introduction of new, automatic effects greatly reduced the time needed to make speed and feed changes, so that the ram strokes can be varied from 100 per minute to 5 per minute, involving rheostat and back gear adjustments through the full range, in about ten seconds.

The electrically driven shapers are made for both constant and variable-speed motors. In the illustration, a variable-speed motor outfit is shown. The constant-speed motor requires a four-step cone on the armature shaft, corresponding to the cone on the shaper, for obtaining the variations in speed, which, taking the back gears into account, are eight in number.

All the details of these shapers and their driving mechanism have been most carefully worked out, and the result has been one of the most perfectly speeded tools ever built. Further information will be gladly given to all interested persons by Gould & Eberhardt, of Newark, N. J.

National Upright Drill.

THE accompanying illustration shows the latest 20-inch upright drill brought out by the American Tool Works Co., which is of entirely new design throughout, heavier, stronger, and more compact in every way than their former patterns. Column, base, table and pulleys are all of liberal proportions and ample weight. The table is raised and lowered by screw and crank. The spindle is of special hammered steel, has patent quick return and is counterbalanced. The bevel gears are of coarse pitch and planed theoretically correct from the solid.

The power feed is engaged or disengaged by a friction clutch, operated by a knob conveniently located. The automatic stop to down feed is set by graduations on the spindle, and is readily adjusted.

The back gears, a new feature on this size of drill, are wide face and coarse pitch, and are engaged or disengaged very quickly and easily. The shifter is so located that the machine can be started or stopped by the foot, leaving the hands free to hold the work. All levers and handles are placed so as to be easily operated by the workman without change of position.

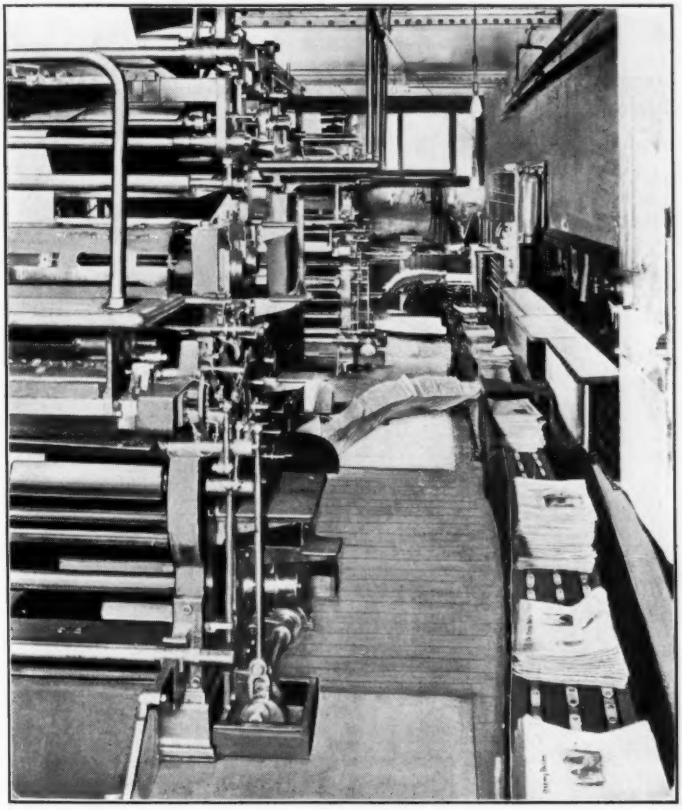
This drill is equipped with (*a*) wheel and lever feed; (*b*) wheel and lever feed and back gears; (*c*) wheel and lever feed and automatic power feed; also automatic stop; (*d*) wheel and lever and automatic power feeds, back gears and automatic stop; and any further information concerning it will be cheerfully furnished by the American Tool Works Co., of Cincinnati.

20-INCH NATIONAL DRILL.

Link-Belt Carrier.

THE Link-Belt carrier which has been recently installed in the press room of the *Philadelphia Evening Bulletin* is unique in several features. There are three parallel roller chains, of special design, running on edge. The conveyor trough is of sheet iron and of sufficient depth to carry piles of 200 papers safely. The action of the carrier is steady and practically noiseless. Its trough occupies scarcely 2 feet in width and it winds in a tortuous course around vari-

ous obstructions in the most amazing fashion, always with the same easy movement of well-oiled regularity. The chief engineer of the *Evening Bulletin* has supplied an auxiliary carrier from the fly box of each press to the side of the main carrier. It consists of two parallel Ewart chains which convey the papers from the fly box to a shelf alongside the trough of the conveyor. The fly



THE LINK-BELT CARRIER IN A PRESS ROOM.

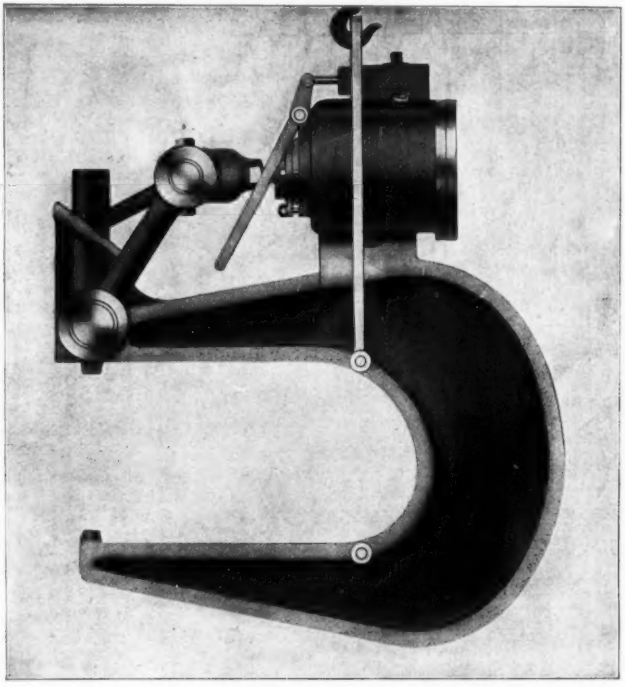
boy is thus able to stand upright and to lift the papers easily, in counted bundles of 50, to the chains of the carrier. The movement of this auxiliary carrier is so timed that the ink dries sufficiently in transit to prevent smudging of the papers in handling.

There are seven large quadruple presses in the *Bulletin* press room, each rattling off finished 16-page papers at the rate of 24,000 per hour, or 8-page papers at the rate of 48,000 per hour. Before the introduction of the Link-Belt carrier, 14 men with 14 trucks were kept busy carrying these papers from the fly-boxes to the circulation department. The carrier does away with all these men, their confusion and wages, and does the work better, quicker and with unvarying efficiency. The president of the *Evening Bulletin* states that if the carrier did not save a penny in wages, it would still be a good investment, because it dispenses with the maddening confusion caused by 14 healthy men rushing to and fro with their 14 trucks in the none too ample avenues between the rapidly moving presses. The

Link-Belt Engineering Company, of Nicetown, Philadelphia, who devised and installed this very excellent conveyor, will doubtless gladly answer any questions which may arise regarding it.

Chicago Compression Riveter.

PNEUMATIC tools are finding a wider and wider application, and many new forms are being used in a great variety of work. Among the apparatus recently placed upon the market by the Chicago Pneumatic Tool Co. is one designated as the "Chicago Compression Riveter," which is shown in the accompanying illustration.



CHICAGO PNEUMATIC COMPRESSION RIVETER.

These machines are designed principally for structural work and those already disposed of have met with unqualified approval of their users. They are manufactured in two sizes, Nos. 1 and 2, the No. 1 having a capacity of from ½-inch to ¾-inch rivets, and the No. 2 a capacity of from ⅞-inch to 1-inch rivets.

The principal parts comprised in their construction are a cylinder, toggle joint, plunger and frame. The piston rod connects two levers of different length forming the toggle joint; the lower ends of the larger levers are fitted to trunnion bearings on the frame, and the end of the short lever is fitted to a bearing block in the plunger. The die holder is screwed into the lower end of the plunger, by which arrangement any desired change in the distance between the dies is easily effected. The plunger has a 3½-inch stroke and acts in a direct line with the axis of the rivet. The machine is balanced in any position and hung by a bail, enabling the operator to turn it in any desired direction with slight effort.

The No. 1 machine consumes but 3.36 cubic feet of free air per minute and the No. 2, 4.8 cubic feet, while the air pressure

on rivet with the No. 1 is 36 tons, and with the No. 2, 60 tons.

Further information regarding these rivets, and other kinds of pneumatic tools as well, will be cheerfully furnished by the Chicago Pneumatic Tool Co., of Chicago.

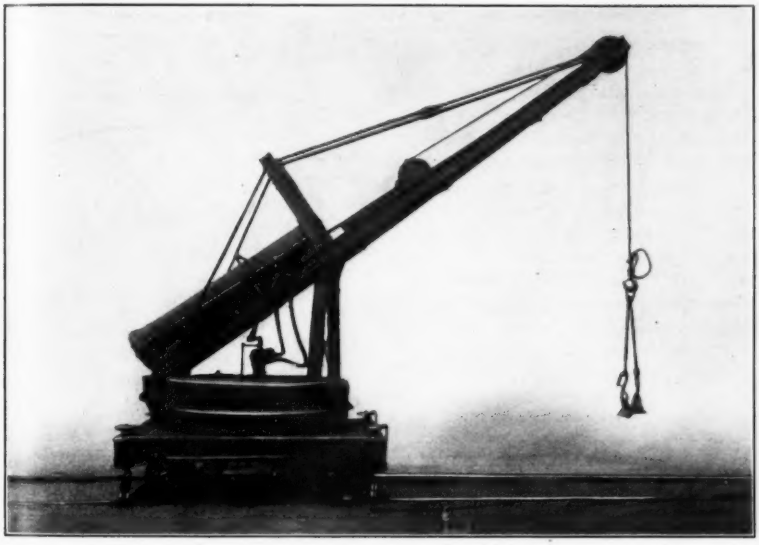
Pneumatic Revolving Cranes.

THE Garry Iron & Steel Co., of Cleveland, Ohio, manufacture the pneumatic revolving cranes, one type of which is illustrated herewith, and which are made in two forms.

convenience in moving about in storerooms, warehouses or on platforms.

Unless specially ordered the crane cars are equipped with a set of rail clamps which secure the car to the rail to prevent tipping when lifting the load; the machines within themselves not being heavy enough to prevent tipping without anchoring. On special orders cranes are furnished with a counter balance on the turn table which obviates the use of the rail clamps.

The cars are of extra heavy design and of liberal proportions. The crane base is bolted directly to the car, having a machined



GARRY PNEUMATIC REVOLVING CRANE.

Form B has a capacity of 1,000 pounds with 7-foot reach, 12½-foot hook lift, and a total height from the rail to the top of the boom of 9 feet, 2 inches. Form C cranes are of similar design to that of form B, but in capacities of 2,000, 3,000, 4,000, 6,000, 8,000 and 10,000 pounds, with a standard reach of 12 feet, a standard hook lift of 12 feet, 6 inches and a total height from rail to top of boom of 15 feet, 8 inches.

Both form B and form C cranes are mounted on a standard car and arranged for standard track gauge. The gauge may be altered to suit requirements or the cranes may be mounted on special hand trucks for

ball race at its upper edge which contains 193 ground steel balls. The bottom of the base is machined to receive the cylinder, rack, guides, pivot and stop. It has a projecting ring, the underside of which is machined for rollers and brake. The brake bracket is equipped with rollers and air cylinder actuated by a foot valve convenient to the operator and is attached to the turn table, platform and hoisting cylinder, on top of turn table. The hoisting cylinder is securely fastened to the turn table and the brake bracket, and is additionally supported on the top of the turn table by means of the vertical members of the boom proper, which

are attached to the top turn table. The air for hoisting is applied to this cylinder.

Booms are made of heavy channels stiffened by top truss rods. Cables are ordinarily made in two parts for 12½-foot hook lift which may be modified to suit the hook lift required. The air is applied in such a way as to permit the operator to stand on top of the turn table and handle the crane for all movements without changing his position.

The Garry Iron and Steel Co. also manufacture pneumatic cranes having a horizontal boom with trolley which racks in and out on the boom, thus giving four applications of power.

The standard type of crane can be furnished with a motor for traversing the car up and down the track, or with hand power traversing arrangement if desired.

These cranes are particularly useful in loading canal boats and freight cars, for coaling locomotives and for all purposes where heavy lifting is required. The workmanship on all the cranes that this company manufacture is first class, and the materials the best of their several kinds. Each crane is tested to its full capacity before leaving the works.

The manufacturers of these cranes will build cranes to any specifications and for any and all purposes, and build traveling cranes for shop purposes to specifications. They also do general machine and structural iron work, and manufacture roofing, siding and pneumatic painting machines, and will be glad to give any further information desired.

Haeseler-Ingersoll Air Hammers.

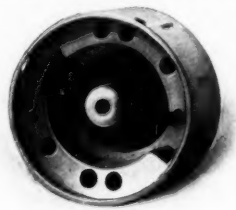
THE highest degree of excellence yet attained in pneumatic hammers is represented by these tools. The features of marked improvement, as compared with other pneumatic hammers, are the valve mechanism for reciprocating the piston, a locking device for taking up wear and securely locking the handle, valve box and cylinder of the tool together, and a simple arrangement of throttle valve for controlling the admission of the air supply.

The valve is a radical departure from the various forms of straight-line reciprocating valves ordinarily used. Its strength of construction, steadiness in action and freedom from wear overcomes the recognized defects in valves heretofore employed in connection with other pneumatic hammers. As its name, "axial valve," implies, its movement is around a fixed axis or trunnion, the travel forward and back, to alternately open and close the admission and exhaust ports, being caused by a constant air pressure upon the short wing or projection of the valve and intermittent air pressure upon the long wing.

11 C

HAESELER AXIAL VALVE.

The ports in the valve, as well as those in the valve box, are relatively of equal areas, and are located diametrically opposite to each other, so that any pressure against either side of the valve is equalized by a corresponding pressure upon the other side, resulting in a balanced valve and consequent absence of friction and wear on the trunnion or axis about which the valve moves.

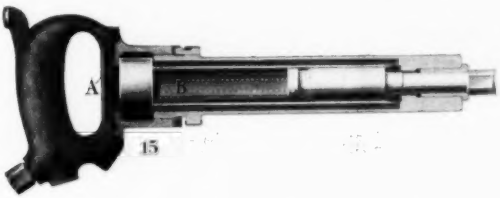


11 B

INTERIOR OF VALVE BOX.

As the movement of the valve is transverse to the direction of the travel of the hammer or piston, the vibration of the entire tool is lessened in operation, and the action of the valve is not disturbed when the hammer blow is struck, but is quick, steady and uniform, and entirely free from the fluttering or incomplete travel which is common with valves moving in line with the piston.

The valve is steel, drop forged from selected stock, is hardened, accurately ground to gauges, interchangeable, and guaranteed against any breakage from service. The valve box is also made of steel throughout, with all surfaces ground.



SECTION OF HAESELER CHIPPING HAMMER.

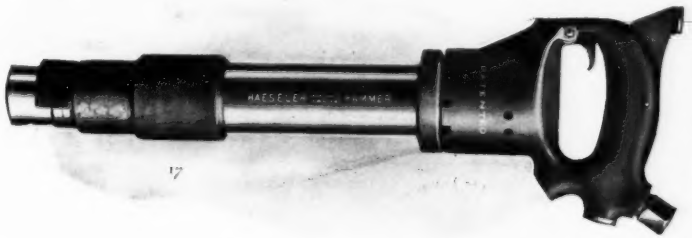
The efficiency of a pneumatic hammer is seriously impaired if the joints between the faces of the cylinder, valve box and handle are not kept tight. See A and B on cut.

To insure keeping these joints tight, by securely locking the parts together, there is provided a simple and strong construction, consisting of a number of slots in the collar of the cylinder and a different number of notches in the end of the handle, the one number not being a multiple of the other. This arrangement permits a fine adjustment to be made when it is desired to take up the wear of the parts, as a notch in the handle will always be in line with one of the slots in the cylinder, without regard to any required position of the handle being necessary.

When the handle is screwed up tight, the parts are locked together by a key being inserted in the registering slot and notch referred to, and this key is held in place by a spring band being snapped over and around the collar of the cylinder.

Haeseler-Ingersoll chipping hammers are made in five standard sizes, with strokes ranging from one inch to five inches. The long stroke riveting hammers are in three sizes, with strokes of six, eight and nine inches, respectively.

Full details of these tools and any further information desired will be cheerfully given by The Ingersoll-Sergeant Drill Co., of 26 Cortlandt St., New York.



HAESELER RIVETING HAMMER.

Hand Milling Machine.

THE Chicago Machine Tool Co. are doing some very commendable work in the production of new machines, to which end their main force seems to be directed. One of the latest of their products is a moderate priced hand miller. This machine is built in three sizes, and can be used on a bench, or can be supplied with an iron standard. In either case, the machine is very substantially built, and has a very large range and capacity for its size. The addition of the vertical spindle greatly increases the variety of work which it will do.

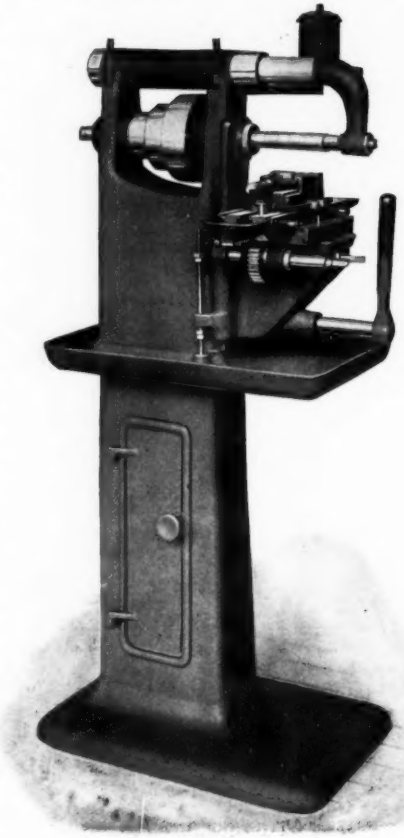
The spindles are interchangeable on the same machine. When the vertical spindle is slipped off the sleeve, the overhanging arm is inserted in its socket, as shown by the accompanying illustration.

The table and knee have both lever and crank motions, the table having longitudinal and transverse motion. The knee and table both have very convenient adjustable stops.

Another new feature of the "Chicago" tools is self-oiling bearings, with which they are supplied. In the journal is a wick which dips into an oil receptacle below the spindle, and thus the bearing is constantly lubricated, and as no dirt can get into the bearing, and no oil can work out, the machine is very clean. The oil receptacles need only be filled once in about three or four months.

The spindle is of steel and hollow. It is threaded on the end to receive a protecting nut, or chucks and face mills, when desired. This is a noteworthy feature. This thread also serves to force the arbor out of the taper hole in the spindle, which is a great convenience. A finished arbor is furnished with each machine, and each spindle is supplied with a drawn-in-collet mechanism. The knee is of box section, the strongest form it could have, and is very rigid, with the employment of the minimum of metal for the required strength

Each machine is fitted with a special quick acting vise operated without any screw. The handle is merely moved over to tighten it up, and a nut loosened when different sized pieces of work are to be inserted. This is one of the great advantages of this miller in the reproduction of small parts. There is an oil channel cast all around the vise, so that it sets on the table clean and dry.



CHICAGO HAND-MILLING MACHINE.

Another very important point in favor of the "Chicago" tools is the patent "Pullet" countershaft, which goes with each outfit. This is a friction countershaft actuated by a weighted lever, so arranged that by pulling a cord, the balance weight is shifted, thus throwing in the friction clutch, and a second pull on the cord again changes the position of the balance weight, and the clutch is thrown out. It is called the "Pullet," because the cord is pulled to start or to stop. This countershaft is also supplied with self-oiling bearings which only need attention about once in three or four months.

Any further information concerning these millers, or any other machinery made by the Chicago Machine Tool Co., will be gladly furnished by Hill, Clarke & Co., of Boston.